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Electrical Engineers and the War

Their Vital Role

IN spite of the strenuous efforts of the British Government to avert war, this monstrous evil has been forced on us. There is no need here to voice the just indignation felt by men who have wished only to continue on the path of peaceful progress against those who have devised this outrage to civilisation. Nor do our readers require to be reminded of what would be the consequences of any weakness in meeting this wanton challenge.

Strong natural feelings, even though they lend driving force to our effort, will not of themselves enable us to win through. What is needed is clear thinking, and for clear thinking cool heads are essential. This applies especially to electrical engineers, whose destined part in the defence of their country can hardly be overestimated. During the last war electricity, by common consent, contributed largely to the success of the allied cause, and in those four years the consumption of electricity increased enormously. Yet at its close the output of electricity supply undertakings was less than a fifth of what it is to-day.

Increased Responsibility

The difference between then and now gives some measure of the increased responsibility of electrical engineers. But it is by no means the only measure; nor does it adequately reflect the great overall improvements in the electrical position. In the intervening years the value of research has come to be recognised and many investigations now in embryo in our laboratories will, it can safely be anticipated, come to earlier fruition under the stimulus of necessity.

Reliability of electrical apparatus has unquestionably improved within the past twenty years. It is true that we have cashed in on many of the products of research in the interests of efficiency, but the margin of safety has more than proportionately expanded. Again, experience in the design of the grid has enhanced the ability of our manufacturers to cope with large-scale supply problems. Standardisation of frequency also is another asset in that it will facilitate meeting the demand for urgently wanted electrical apparatus. Nowadays, too, electricity is much more widely available. Finally, there are the strides made of late years in communications and light-current engineering generally.

On the operation side we cannot expect the economy in fuel consumption achieved through inter-connecting the most efficient generating stations to be maintained. Apart from a probable further advance in the price of coal, it may be inexpedient to rely to the same extent as hitherto on the running of the best machines at their most economic ratings for providing almost the whole output.

The question of how far local loads should be dealt with by existing local stations, in the interests of greater security, will probably answer itself by the need to run available plant all-out to meet increased demands for power. That at any rate was the experience of the last war.

Reliability of Supply

In any event the grid is ready to provide supplementary supplies or stand-by should a station be put out of commission, wholly or partly, by enemy aircraft. This greatly reduces the risk of a locality being without electricity for an indefinitely prolonged period as might otherwise happen. In addition there is the national pool of transformers and switchgear that has been formed for war emergency which, together with more rapid high-voltage jointing, should minimise the time required to restore supplies. Also many bulk supply connections have been rearranged with the same end in view.

On low-voltage distribution networks, elaborate precautions have been taken by undertakings, as our columns have indicated, to limit the area affected by local interruptions of supply due to enemy action.

Regarding the personal element, many men in the electrical industry will feel the urge to offer themselves for active service in one form or another. Those doing so should endeavour to ensure that their specialised skill is employed to the best advantage, and the I.E.E. Register should provide a valuable safeguard here. In one sense, however, all will be on active service, a large proportion carrying on their normal occupations in an intensified form.

We may feel confidence in the outcome. Behind all the resources in quality of men and material that the electrical industry can bring to the common weal is that steadfast " faith in the ultimate decency of things " which will be the moral basis of our actions in the time ahead of us.

The "Review" in Wartime

As during the last war, the ELECTRICAL REVIEW intends to carry on its activities as an essential link between the various branches and units of the electrical industry. There will, of course, be many difficulties but steps will be taken to overcome them as they arise. There is one immediate matter which we have to mention. It is necessary to commence the strictest economy from the outset. Consequently we are limiting our printing order this week to what we believe to be the essential requirements. Readers who have not placed a standing order with their newsagents should therefore do so at once or make a regular purchase from a particular agent or bookstall to ensure that they continue to receive the "Review."

Meetings During War

As dispersal of population is relied upon as a means of minimising the effects of air attack, it is an obvious precaution to close for the time being all places of amusement. It is certainly of no less importance that engineers should not congregate in large numbers in the same place. It might well be a national calamity if one of our institution buildings or other premises used for holding technical meetings were seriously involved in an air attack during the reading of a paper at which some of the ablest men of the electrical industry were present. On the other hand, it is perhaps more necessary now, than ever before, that electrical engineers should have opportunities of hearing the views of their colleagues. As Dr. A. P. M. Fleming pointed out last week in his presidential address to the Educational Science Section of the British Association, so quickly are new technical processes introduced that text-books can never be completely up-to-date. The best way of obtaining information as soon as it becomes available, is normally through the institutions or the technical Press. Whatever steps it may be found desirable to take to minimise risks accompanying the congregation of individuals, the industry can rely upon the technical Press to pull its weight and to continue to deserve the handsome tribute paid it by Dr. Fleming in his presidential address to the I.E.E. last autumn.

The Importance of Light

We suppose that some form of apology, or at least explanation, is necessary for our temerity in persisting with the publication of our annual lighting number. As we remarked last week, war or no war, light is still essential. Indeed in many directions it is more important than ever that there shall be adequate illumination and most certainly economy and efficiency are leading factors in such a time as this. Consequently we have no hesitation in publishing for the benefit of our many readers who are engaged in the illuminating engineering industry, as well as those who are users of light, this series of informative articles by acknowledged authorities on the subject. The contribution by Mr. W. Robinson on factory lighting certainly needs no apology. It deals in a practical way with a matter which the national need for rapid and accurate production places in the front rank for immediate attention.

Modern Photometry

Recommended values of illumination having been determined it becomes necessary to look for a "yardstick" to measure them by. The unaided eye is an unreliable guide and the eyes (and preferences) of individuals vary a great deal. Consequently photometry has to be called upon if an installation is to be planned on a calculated, scientific basis. The name of Dr. J. W. T. Walsh is one of the first to come to mind when illumination values are discussed; no committee on the subject is complete without him. All of this lends weight to his survey of recent developments in photometry which is another of our series. He mentions the probability that the search for a reliable primary standard of candle-power is likely to culminate in the adoption of a "black-body" radiator which employs the temperature of solidification of molten platinum as a basis. The unit developed in this way is very nearly identical with the unit of candle-power now in use. Dr. Walsh describes the construction of the apparatus employed in producing the standard and he also deals with the latest developments in the use of photocells, integrators and illuminometers in photometry.

An Authorised Undertaker?

THE September *Journal* of the Incorporated Municipal Electrical Association reports that a member has made representations to the Council that his authority should be in Group C, inasmuch as it sells the whole of its energy generated to the Central Electricity Board; the Council is giving the matter consideration. The articles of association, dealing with the payment of subscriptions, provide that "the number of units sold" means all units generated or purchased by a member, less the total . . . units sold in bulk to authorised undertakers." The I.M.E.A. *Journal* says, therefore, that it will be seen that the question is as to whether the Central Board is an "authorised undertaker" within the meaning of the Electricity Acts. The answer would appear to be in the affirmative, for Section 20 of the 1926 Act says that, subject to certain provisions of the Section, "the Board shall be deemed to be undertakers and authorised undertakers within the meaning of the Electricity (Supply) Acts, 1882 to 1922."

"Cold Snap" Charges

AT an interview with representatives of the I.M.E.A. recently, the Central Electricity Board expressed its inability to adjust or spread the extra fixed charge for grid supplies incurred by some undertakings as the result of the sudden cold weather in December last. The Board amplified the arguments which appeared in its annual report for 1938, and, in effect, told the complaining undertakings that their charges should have been such as to provide for such a contingency, or that other provision should have been made. The possible alternative of basing the kilowatt charge upon the average of the maximum demands recorded in any half-hour during *each* of the four winter months was held to be inequitable to undertakers with steadier, largely industrial, loads. The Board deprecated any restriction upon the development of the heating and cooking load to avoid a repetition of the experience, as such a policy tended away from the diversity which such a load represented.

Power Station Emissions

THOSE who fear lest the erection of a new generating station in their neighbourhood will pollute the atmosphere might consider the Report on Alkali, &c., Works for 1938. Reference is made there to complaints received regarding grit that was alleged to be discharged from the chimneys of a generating station, whereas the bulk of it was proved to be emitted from a neighbouring works. Similar investigations would no doubt exonerate other stations now under a cloud that is not of their own making. Figures given for the operation of the gas washing plants at Battersea and Fulham power stations show that, in the words of the Chief Inspector, "a modern power station producing a vast quantity of energy, which can replace coal in the factory and home, can itself burn coal to an extent approaching half a million tons per year with no appreciable emission of smoke, dust or harmful oxides of sulphur." The cost of gas cleaning is, however, high, but it should be quite unnecessary to strive to emulate the remarkable achievement of Fulham, where the total acidity corrected to a 10 per cent. CO_2 basis is shown by the average of official tests to be only 0.0043 gr. per cu. ft. at n.t.p.

FACTORY LIGHTING

Systems and Layouts

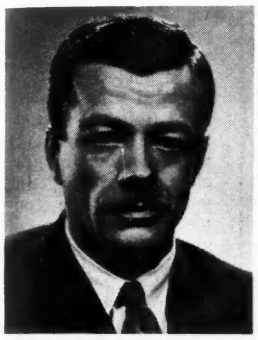
By W. Robinson, B.Sc.

THE requirements of a factory lighting installation are, broadly, as follows:—There must be an adequate value of illumination; the illumination must be uniform; no direct or reflected glare should be permitted; there should be no undue brightness contrasts; and, finally, there should be no hard shadows.

In general it is not sufficient to estimate the wattage required on a watts per sq. ft. basis and it is now customary to select the appropriate value of illumination required by reference to authoritative tables such as the I.E.S. code or the E.L.M.A. Handbooks.

It then becomes necessary to lay out the installation in such a manner as to comply with the other requirements tabled and it is with the object of assisting in the planning of new systems and the assessment of old systems that these notes have been prepared.

Factory lighting is at the moment of greater, not less, importance than before. The author stresses this by quoting a Home Office pronouncement and deals with the principal considerations in planning works illumination



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Lighting Methods

There are three main systems of lighting which conform to the above requirements, *viz.*, symmetrical general overhead lighting; localised overhead lighting; and combined general and local lighting.

The most useful, and hence the most usual, of these systems is the first. In all situations of average ceiling height, free from obstructions, this system holds undisputed sway and, except for places or work calling for specialised lighting, may safely be chosen. A symmetrical layout provides substantially uniform illumination throughout the shop and possesses the great advantages that work can be carried out with equal facility in any position and that should it be necessary to alter the layout of the plant no alteration to the lighting system is necessary. There is ample headroom and freedom from glare, shadows and undue contrast, while the absence of local lighting makes possible the use of high wattage lamps with their increased efficiencies.

Maintenance costs are also lower due to the smaller number of light points and their remoteness from the plane of work.

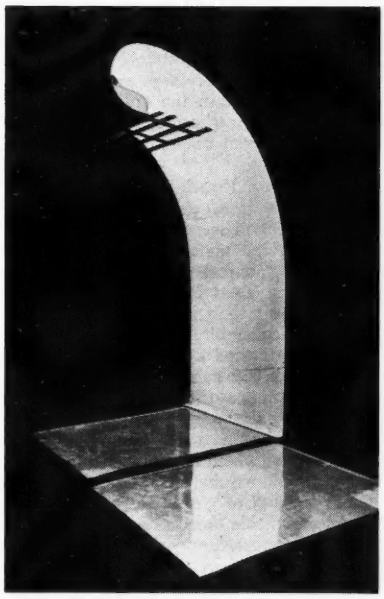

Fig. 1.—Inspection of polished metal sheets

The success of this layout depends, however, on correct application of the lighting equipment with due regard to the reflector characteristics. The standard dispersive reflector or the industrial diffuser are especially suitable, the latter particularly in cases where fine work or inspection requires high intensities or where a better quality of light justifies the additional expense. In the former cases the spacing of the reflectors must not exceed 1½ times their height above the working plane, this being usually 3 ft. from the floor; in the latter case rather closer spacing is required.

Clearly, then, such a lighting installation is laid out initially without regard to the size of lamp which will be used but purely out of consideration of uniformity. The usual design practice is to work back from this layout to obtain the required lamp wattage and to side-step the once inevitable mass of calculations by use of the exceedingly valuable "coefficient of utilisation" and associated tables which are now available and which experience has proved to give extremely accurate results under all conditions.

Localised overhead lighting is similar in principle to the general lighting system excepting that the fittings are grouped in accordance with the demands of the plant or machinery whose top hamper or bulk would interfere with a general overhead system. Any rearrangement of plant will, of course, necessitate modification of the lighting installation, but there are many factories, particularly in the textile industry, where this localised method of lighting is desirable.

Fig. 2.—Lighting metal-scribing machines

Combined System

An installation combining general with local lighting is called for in those shops where high values of illumination are required for fine and exacting detail work, or, alternatively, where the work necessitates directional lighting.

It is essential to consider the local lighting as supplementary to a general lighting system which gives a moderate level of illumination throughout the interior. This ensures that gangways and other extraneous areas are not left in darkness, and also obviates sharp contrast in the illumination which may otherwise give rise to eyestrain, and accidents. In some cases, the complicated nature of the plant necessitates the mounting of local lighting on the machinery, and in these cases the adjustable type of local fitting with a deep reflector should be used.

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From the foregoing it is clear that, if complications do not arise, the planning of a lighting system to give uniform, glare-free illumination over an open area presents no great difficulties and any reasonably intelligent person can, with the information available, arrive at a result varying very little from the calculated value. This is a triumph of simplification when it is realised that the old mathematical method, upon which the present-day method is based, demanded hours of calculation by an expert with a result not highly accurate in the resulting design.

Complications, however, are never absent from illumination schemes, and though a basis of planning has been indicated it must not be assumed that factory lighting can always be efficiently provided by using a standard layout. In many cases the system must deviate from standard or additions must be included and it is in the solution of such special problems that particular care and knowledge are essential.

A special lighting problem is presented, for example, by the inspection of tin plate or polished metal sheets. It will be interesting to run through an analysis of this problem and observe how this same method of analysis can solve many similar lighting problems.

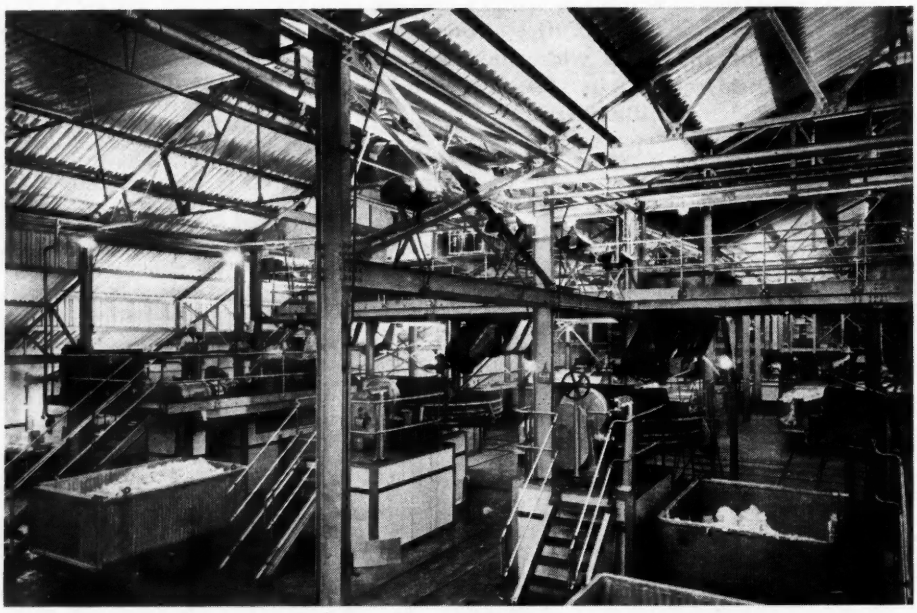


Fig. 3.—Indirect lighting, avoiding danger of falling glass.

The visual task involves discrimination of fine lines and minute surface scratches under conditions of direct, specular reflection from the light sources to the workers' eyes for long periods without rest. Notice that the operation is considered from the viewpoint of severity of visual task, physical conditions (this may be extended to cover any relevant mental or psychological factors) and duration of task. A logical consideration of these factors must lead to conclusions similar to the following:—Severe task needing adequate intensity, say, 15-25 ft.-candles. The light source must be of very low brightness, since its reflection is directly viewed by the worker; hence the surface area of the source must be correspondingly large to provide the necessary illumination.

Thus our method of approach eliminates guesswork from the beginning and substitutes a process of reasoning. The final solution is now largely a matter of mechanical or electrical ingenuity in interpreting the requirements thus deduced.

Fig. 1 indicates a practical modern solution and it will be seen how the theoretical requirements are interpreted. The picture also shows an interesting modification which, while conforming to the general conditions, yet exercises a separate function in that the extent of distortion in reflection of the black bars gives in addition a perfect measure of the flatness of surface of the object under inspection.

Another Analysis

The operation of metal scribing by machine is selected as a lighting problem of real complexity. On analysis it is a task involving severe and critical discrimination and intense concentration at one point where shadow is likely to mislead the operator and cause error and specular reflection would be troublesome. The task may be of long duration without rest.

The ideal solution, then, appears to be high intensity, highly diffused lighting from a large source, shadow and specular reflection being thus practically avoided. One point does not immediately suggest itself, however, and that is that observation of fine scribing marks is improved by using a form of *directional* lighting. Thus the solution gradually evolves, without practical experiment, into the form shown in fig. 2, and again it will be noticed how a correct and practical result can be arrived at merely by intelligent analysis of the problem combined with a little ingenuity. Note how the requirements are satisfied in the installation shown; high intensity indirect light from the *side*, giving the minimum of reflected glare, allowing free movement of the worker and producing what little shadow there is in the same direction as that cast by daylight coming through the windows where the blinds are not drawn.

These two examples are put forward not as typical problems or solutions particularly useful in themselves but as indicative of the excellent results that can be obtained by a systematic approach which excludes casualness and guesswork, and it is, alas, too well known that these latter symptoms are depressingly prevalent in most factory lighting practice to-day.

Further Examples

It will be interesting to mention two other well-known lighting problems along the same lines. The detailed analysis will be excluded for brevity but it should not, therefore, be assumed that the solution was obtained without this process; on the contrary the process of analysis, consideration and practical interpretation of the theoretical findings is indispensable.

In machine shops with overhead drive the problem is that the shafting and belting absorbs much of the light from an overhead system and moving shadows produce difficult and often dangerous working conditions. The solution is to raise the illumination intensity to an average of not less than 10 ft.-candles and to diffuse the lighting. Care should be taken to ensure that the reflectors' edges are below the shafting height and that small power sources closely spaced are used, *not* large sources at wide spacing. It is worth noting that in the ordinary light machine shop a correctly designed overhead system may obviate the necessity for local lighting even under the disadvantages just discussed.

Food Factory Lighting

In food factories the visual task is a normal one, but there are certain special requirements which call for special attention to the method of lighting and type of equipment used. The main requirements are that the product being manufactured must be immune from the danger of foreign bodies falling into it as a result of lamp breakage, &c.; vapour or dust in flour mills, &c., is likely to be present, and fittings should be protected against this; and the lighting equipment should assist the general cleanliness of the factory and its appearance, since these factories are particularly liable to inspection by the public.

These requirements can be met in various ways, the most satisfactory of which is the use of totally indirect lighting. One method is shown in fig. 3, this gives maximum immunity against the fall of glass, &c., in the event of breakage since the reflector holds the broken pieces. This method, employing miniature projectors inverted, has several advantages over the usual indirect pendants such as the presence of cover glass facilitating maintenance, absence of interference of head-room, &c. This system is particularly suitable for premises with very low ceilings and would be found useful for multi-storey flour mills since no pendant fittings are necessary. In this and similar cases, however, care must be taken to ensure that the fittings are dust explosion proof.

Where direct lighting is preferred enclosing fittings should be used, which, while not necessarily being watertight, should

MORE LIGHT?

Fixing Minimum Standards of Illumination

By J. S. Dow

A controversy recently arose in our pages regarding the proper levels of illumination. Mr. Dow surveys the question in a judicial manner and suggests ways in which the study of the subject can be objectively approached

HOW much light do we need? Although the study of this fundamental problem has been pursued for at least thirty years—since the Illuminating Engineering Society was formed in this country—it still remains difficult to answer this apparently simple inquiry. During this period the trend of values of illumination has been steadily upward, and doubtless this tendency will continue. There are those who contend that, so far as artificial light is concerned, we are even now living in "a half-seeing world," and that nothing less than the volume of light obtained under natural conditions from the sun and the sky will finally satisfy. The argument is based in part on the contention that the human eye has been for countless years developed to make the best use of daylight.

Opponents of this view counterclaim that natural light, as exemplified by daylight at different times and seasons, twilight and moonlight, varies within enormous limits, and that the main feature of the human eye is its remarkable power of adaptation, which enables it to work comfortably over a very wide range of illumination. Ease in seeing, it is further suggested, depends only in part on the illumination in foot-candles. It is just as important to ensure that there is no element of glare or troublesome contrast to perplex the eye and diminish the "subjective brightness" on which perception ultimately depends.

The importance of such factors has received a good deal of recognition in the United States where the tendency to provide illuminations considerably higher (up to 50 ft.-candles or more) than are usual in this country has brought with it a special technique, involving the use of indirect or louvre fittings in order to diminish glare.

Apart from the recognition of the desirability of higher levels of illumination, there is the question—primarily economic—how far one should go to satisfy the craving for more light. There is no doubt that the mere fact of light being available more cheaply—thanks to recent advances in the efficiency of illuminants—has been largely responsible for the rising level of illumination. But there is a marked difference in the reaction of those concerned in the different fields of lighting.

In such cases as the lighting of shops, stores, cinemas and places of entertainment, it is broadly true to assert that it is only the *effect* that matters; if it is certain that higher illuminations will attract and please, the cost is a secondary consideration, because the spender is satisfied that he gets a more than compensating return for his outlay. In the field of street lighting on the other hand (where possibly the need for improvement has been greater than in most others) it has been until lately most difficult to induce authorities to consent to generous advances because those who foot the bill (the ratepayers) are not clearly conscious that they derive a compensating personal benefit, and the authorities are chary of incurring increased expenditure on their behalf.

In other cases we find an intermediate position. A humane factory owner will admit that it is his duty to provide lighting that eliminates, so far as possible, actual danger of accidents or overstrain to his employees. Cases where there is obvious neglect to this extent are almost invariably due simply to ignorance or extreme poverty. It is, however, by no means easy to *prove* that lighting below a certain level occasions these dangers, and in practice the fault is just as frequently one of glare or troublesome shadow as deficiency in light.

When we step beyond this point to the higher values of illumination the readiness of an employer to increase his lighting depends largely on his belief in the economic advantages of good illumination. Yet even if it is established that doubling the illumination will produce an appreciable improvement in output or quality of work, it does not follow that the employer will consider this gain worth while. But it is evident that if people are to be compelled to adopt certain values, it will be to prevent danger or suffering and not to secure enhanced efficiency.

One finds, therefore, that there are broadly three types of standards in general use. (1) Legal standards, such as those proposed in the Report of the Departmental Committee on Lighting in Factories. (2) Recommendations based on good general practice. (3) Recommendations based on ideal performance. Of these, legal standards (1) are necessarily very much less than (2), and the latter in turn are in general less than (3), which are rarely attained in practice.

We now come to the important question how such values should be defined and measured. The second class corresponds closely to the "recommended values" of the Illuminating Engineering Society, which are based on seven main ranges of illumination, according to the nature of the task, in terms of which various typical problems (*e.g.*, the lighting of offices, schools and various types of factories) are classified.

This general classification is doubtless an improvement on

Factory Lighting (*Concluded from previous page*)

be protected against excessive dust or vapour. The industrial diffusing reflector or the standard dispersive reflector fitted with a diffusing cover glass are suitable fittings. Whichever system is used it is important that the general overhead lighting shall leave no dark spaces or corner in which dirt or perishable stores could accumulate unnoticed.

Discharge Lamps

In the foregoing discussion the question of lamps has not been mentioned. Perhaps the tacit acceptance of the electric lamp, and the easy assumption that for all requirements a suitable lamp will be found as a matter of course, is the greatest compliment we can pay to the lamp manufacturers who have brought about this happy condition. We should not, on that account, forget that selection of the right lamp is a matter of the utmost importance.

In particular the use of electric discharge lamps merits consideration for almost any process and the extra initial cost of these lamps will usually be more than balanced by their much longer life and their efficiency of from three to five times that of incandescent lamps. It is also worth remembering that the fluorescent type of discharge lamp exists to meet conditions where the characteristic colour of discharge lamps may be a drawback.

Air-raid Precautions

It is a strange situation, but one which must be faced, in which guidance to good lighting must conclude with remarks on light obscuration, but in the name of sanity let us not run amok over this emergency business and undo the good work of a generation. Consider what the present situation means; it means that industry is to be strained as never before, it means that production must be increased, it means the possibility of unskilled or semi-skilled workmen being called in to make good labour losses. In other words, it means that under the new conditions industry needs lighting more now than ever before.

The requirements of good A.R.P. are that light shall be obscured outside the factory, but to attempt to do this by obscuring the lamps inside the factory is grotesque and quite divorced from the country's policy of "business as usual," providing that this statement is not taken as applicable to exceptional cases such as loading bays, &c. Efficient sealing of all light outlets will be equally effective with good as with bad lighting and guidance on this can be obtained from specialist sources. To those who have not already obtained a copy, the Home Office pamphlet "War Time Lighting Restrictions for Industrial and Commercial Premises" will prove helpful.

I will conclude with a quotation from this pamphlet:—"It is, of course, highly desirable that efficient production and working conditions should be maintained in time of war, and if the screening of windows, rooflighting, &c., has been effectively carried out, factories should be in a position to retain their normal peace-time standard of internal lighting."

the earlier forms of tables in which an attempt was made to discriminate between the lighting requirements of a very large number of processes. In the recently issued recommendations of the Illuminating Engineering Society in the United States, a further step is taken—distinctive letters, indicating not only values of illumination but also special arrangements with regard to nature and position of sources, being assigned to certain processes. It will be readily understood that in the case of certain processes, notably those requiring intense oblique light or depending upon the reflection of light from highly polished surfaces, these recommendations regarding the *quality* of the source and its disposition may be quite as important as the degree of illumination afforded. Such recommendations are frankly based on the consensus of opinion as to what is good current practice, and they are necessarily subject to revision from time to time, usually in an upward direction. Hitherto values proposed for legal standards have been determined mainly in the same manner, though they have behind them a measure of scientific support.

As mentioned previously it is, in practice, extremely difficult to obtain information *proving* that illuminations below a certain value are dangerous or prejudicial to health—even though most of those who have had experience of lighting problems hold definite opinions upon the matter. The only statistical data that can be adduced to show the advantages of good lighting are usually those based upon *performance*. Even these researches need to be conducted with great care and critical judgment in order to separate out irrelevant factors. Various oft-quoted investigations published by the Department of Scientific and Industrial Research are, however, most informative on this point and it is significant that the effect of better lighting on performance and output can be traced not only in the case of fine process, such as typesetting by hand, but also in connection with such relatively rough and mechanical processes as tile-pressing.

By such researches it is possible to go some way towards defining values in Class (3), but the main line of approach is fundamental, *i.e.*, by considering the reaction of the eye to brightness and contrast and the conditions necessary to attain "a hundred per cent. performance," or at least a close approach to the maximum performance possible. From a practical standpoint it will always be a question how near an approach one can make to these ideal conditions.

Various Factors Considered

One of the most interesting approaches to this problem is that given in a paper read by Mr. A. W. Beuttell to the Illuminating Engineering Society five years ago.* In this paper he analysed the various factors on which the illumination necessary for any particular process depends (such as size of object, reflecting power, contrast with background, speed of perception, need for emphasis, &c.), and devised formulæ and tables by the aid of which due weight could be given to each factor for any particular case and the resultant necessary illumination computed.

Although the process is to some extent empirical it has an essentially scientific basis. For a complete solution it would be necessary to study each factor in turn and ascertain the relations, involved, as has been done, for example, very effectively by Mr. H. C. Weston in a recent research.† This study was most instructive in revealing how, when objects of very small dimensions are being considered, exceedingly high local illuminations become necessary. This fully confirms what illuminating engineers have found in dealing with certain very intricate processes in factories for which values of illumination so high as to require special local lighting are commonly recommended.

Application of the method to selected "Recommended Values" in the I.E.S. series yielded promising results. It is much to be desired that this study should be extended and the method placed on an established basis. One of its virtues is its elasticity which enables it to be applied both to office and factory processes and to such problems as the lighting of show-windows or posters (where "emphasis" is an important factor) or the lighting of direction signs or greyhound racing tracks (where speed of perception enters).

Tabulated Data

Whatever the method of evaluation adopted it seems evident that standards or codes must always be supported by tabular data, from which those responsible for the planning of lighting installations can work, though such tables may require revision from time to time. One would imagine, for example, that the scrupulous application of Beuttell's method would often result in "ideal" values exceeding those in practice. Values attained by this process would accordingly be scaled down on a uniform basis to practical levels, which might be raised as the efficiency of our illuminants improved.

Another idea that has sometimes been suggested is the use of some sort of dimming device. It has been proposed that the process under investigation should be examined through a dark glass transmitting say, only 1/50th of the light falling upon it. If in these circumstances the process could still just, but only just, be carried on, the available illumination would be considered adequate. This idea is closely linked with the study of visibility meters, which formed the subject of a recent discussion before the Illuminating Engineering Society. A number of objections were then raised—for example, that it would be fallacious to apply the same reduction ratio to totally different processes. Nevertheless, provided the limitations of the method are understood, the method might possibly be developed into a quick and useful way of appraising the efficiency of lighting—though, in all probability only as an adjunct to and not as the basis of a list of "Recommended Values."

* "An Analytical Basis for a Lighting Code," by A. W. Beuttell, *Illuminating Engineer*, Jan., 1934.

† "The Relation Between Illumination and Industrial Efficiency. I. The Effect of Size of Work" (Issued by the Medical Research Council and the Department of Scientific and Industrial Research (1935).

Who Invented the Telephone?

NO patent has ever led to so much litigation or to so much mud-slinging as that granted to Bell by the United States Patent Office in 1876. After describing the efforts of earlier workers to transmit sound by means of the electric current W. Aitken, in "Who Invented the Telephone?"* gives an account of the work of Bell and his contemporaries, and discusses the litigation and mud-slinging. The material is necessarily very condensed, but the author has deposited in the Science Museum Library at South Kensington an extended manuscript which may be consulted.

The tone of the book may be judged from the following extracts: ". . . . Gray and Bell who applied for patents on the same day. The unfair treatment meted out to the former, and the unmerited honours that were showered on the latter. . . . ." "The work of Edison, Hughes and others, who made the telephone really a commercial instrument." "If we agree to call the true inventor that man who is the first to conceive clearly a new idea . . . then the telephone was invented in 1854 by Charles Bourseul." "Bell's patent which should never have been granted." "Unless all the evidence quoted is to be taken as false, Bell must stand self-condemned," and so on, always in the same strain.

The book naturally bristles with quotations and one from a letter written by Edison in 1877 is striking; "Bell has done absolutely nothing new over Reis, except to turn Reis's from a contact breaking into a non-contact-breaking telephone with permanent magnet and worked the thing up to a success," that is, he had done absolutely nothing except to invent a telephone that would work.

The author occasionally takes liberties with the spelling when quoting; *construire* becomes "*constraire*," *bewegung* becomes "*bewengung*" in two places, and C. E. Webber is misspelt Weber in at least four places. Something has gone very wrong with the English in the opening paragraph of Chap. XVIII, and the statement on p. 187 that "in 1876 the Bell Company got possession of the Berliner patent" cannot possibly be true since Berliner did not file his caveat until April, 1877.

On p. 169 the author, referring to the unveiling of the Edinburgh memorial to Bell, says: "Prof. G. W. O. Howe in his speech said 'The strongest proof that the Reis telephone was incapable of transmitting intelligible speech was provided by the American experts who, in their efforts to prove that Reis anticipated Bell, obtained some Reis telephones from Germany and tried their utmost to make them work. In the controlled tests, out of a thousand words the listeners recognised fifteen and eight of them were wrong.' The author has seen no record of this test . . . . Who were the American experts?"

Their names were Dolbear and Buck, and the author will find the tests fully described in American Bell Telephone Co. *versus* National Improved Telephone Co. Circuit Court. U.S., March 11th, 1886, p. 113. He will also find enough for his purpose in Kingsbury's "The Telephone and Telephone Exchanges; their invention and development," p. 136, an excellent book which can be confidently recommended to the author if he is really desirous of learning who invented the telephone.—G. W. O. H.

(*Pp. 196. Blackie & Son, 50, Old Bailey, E.C.4. Price 5s.)

HOME LIGHTING

Utility, Artistry and Cost

By J. Priest

The author deprecates some modern methods of providing illumination in the home and gives some advice on the choice of fittings having regard to efficiency, decoration and price.

DURING the last twenty years both the method and design of home lighting have undergone a complete and drastic change. This has been brought about partly as a result of economic conditions, but more particularly, perhaps, by the demand of the public for a higher standard of illumination. Simplicity of design has been forced upon the manufacturer by the reduced spending power of the public. The French artists were the first to give effect to this by a complete breakaway from the historic and expensive styles of the Louis and Empire periods. In substitution for these and to meet the changed conditions, they produced a type of fitting which relied for its appeal on the simplicity of its form and the colourful tone of its glassware.

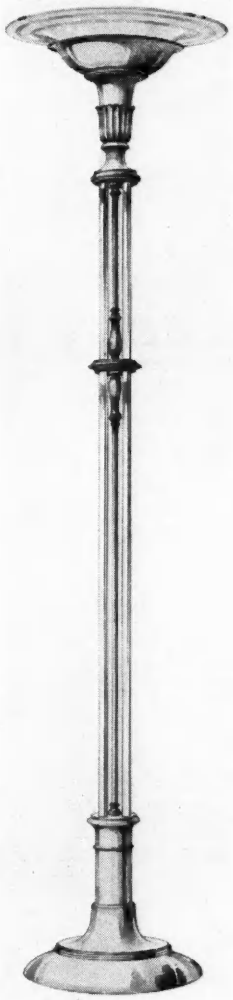
Mr. J. Priest is managing director of Osler & Faraday, Ltd.

Whether it was that English manufacturers were slower to observe the changes which were taking place, the fact remains that instead of creating a style of their own, they have for some years, unfortunately—and I say this advisedly—been following along similar lines. No great skill is necessary to produce this type of fitting and for this reason a new class of manufacturer has been attracted to the industry, with the result that both design and craftsmanship have fallen to a very low level.

Before the introduction of this "modern style" the design of electric lighting fittings had been on traditional lines and considered very casually, if indeed at all, from a scientific point of view. An attractive fitting of a purely decorative character was all that was asked for, and whilst there were some poor examples, there were many extremely fine fittings produced in which craftsmanship excelled and design was of a high standard. Invariably these fittings embodied the use of imitation candles with silk decorative shades, and while these could be most attractive in appearance, their lighting value was extremely low. People in those days, however, were satisfied with a lower standard of illumination and found repose in the dimly lighted corners of their rooms.

It was after the Great War that design entered upon a new phase. The older ideas had gone and the illuminating engineer was making his presence felt, with the result that all preconceived ideas on lighting were being replaced by scientific methods. Research was going on and we were learning the real value of correct illumination. It was realised that the old type of electrical fitting was of little or no value in meeting the more enlightened requirements of the time.

Glass became the chief feature of all fittings. Reflectors were introduced more generally and indirect lighting was being adopted in certain conditions where absence of glare was essential. The earlier glass phase, which was of Continental origin, was responsible for an extremely low standard of design, and for some time it seemed that the "sunray" motif was the one simple idea of all manufacturers. Electrical fittings generally were of poor and freakish design without a redeeming quality other than the fact that the illuminating value was increasing. Then came the "easy to clean" dustproof unit fitting of extremely simple lines, *i.e.*, opal glass spheres and cubes with chromium suspensions, ideal for such purposes as hospital and office lighting, but without attraction for the home.



Compromise was effected by dressing these fittings with haloes or glass discs, and gradually a further advance was made by toning the glassware and introducing colour into the metalwork. With these elaborations they became less commercial and more suited perhaps for domestic lighting, but they lacked artistic merit and were quite inappropriate for decorative and refined home lighting.

Through all these stages it will be seen the object has been to simplify the form and improve the light, but the importance of the design has unfortunately been lost sight of. There are now, however, unmistakeable signs of a swing back to the traditional, but not, of course, in its original form. People want something different and better than glorified office fittings in their homes, and it has been apparent for some time past that there is a desire for more refinement in design based upon the traditional period. In collaboration with the illuminating engineer the designer is now producing models fully efficient in lighting values and at the same time pleasing and artistic in character. To do this something of the old spirit must be acquired.

It has to be visualised how the master craftsmen of the eighteenth century would have applied their art to lighting rooms by electricity instead of candles. Had the brothers Adam, for instance, been dealing with electricity as a medium for light they obviously would not have provided their fittings with candle sockets and grease pans, which are such an essential feature of their designs. It is quite possible they would have enclosed the electric lamp in some form of glass bowl, very much as is being done to-day, but with this difference: the bowl both in form and enrichment would have harmonised with their scheme of decoration in precisely the same way as their chandeliers did.

This, then, is the designer's problem to-day, and he makes no apology for going back to the master craftsmen of the past for inspiration. Provided that he possesses the requisite knowledge of traditional art the task is not necessarily a difficult one, but it requires skill and imagination to treat a new form in a traditional style.

The importance of the decorative value of good fittings cannot be overstressed. They are often more conspicuous in the home than many pieces of furniture, but, unfortunately, they are seldom selected with the same discrimination. They should always bear some relationship to the furnishings and decoration of the rooms which they are to occupy, but how seldom they do!

Good lighting is no longer a luxury but an

essential part of present-day living and the cost of electricity is now so low that many advantages gained both in health and well-being can be considered as one of the economies of the household, but there is no reason for it to be inartistic. Research has shown that in the majority of houses the artificial lighting is totally inadequate to the conditions, particularly when it is realised that approximately half the time we are awake is spent in artificial light. Illumination, however, should not only be sufficient in quantity, but it should be free from glare. Further, it should be well diffused so that contrasts and hard shadows are avoided.

The decorative possibilities of lighting in the home are being more fully realised to-day, and the illumination of flowers, curtains, tanks of fish and panels of glass offer additional attractive features which add greatly to the atmosphere of the room.

In rooms where most time is spent it should be possible to vary the arrangement of and possibly the type of lighting according to mood or circumstances. Combined indirect and direct floor standards, wall brackets and decorative effects on curtains and flowers make this possible.

A correctly designed and well-executed fitting such as those shown in the illustrations will accommodate itself to almost any surrounding whether it be of a contemporary or traditional character. The pendant is a graceful example of "modern period" design. The metalwork is of matt silver with high polished relief, while the glassware is of a cream tone with black lines and with brilliant cut design. A crystal glass ball surmounts the metalwork and the fitting is suspended on a silk rope and tassel. The bracket is of 18th century character, yet embodying the modern half-bowl lighting so prevalent in present-day use. The floor standard is essentially modern in its indirect lighting, with an additional decorative effect given by the luminous glass dish. Three glass rods are introduced around the central upright stem, and such a standard can be safely introduced into surroundings of either "period" or distinctly modern character.

Such fittings as these need not necessarily be expensive; as a matter of fact, there is every reason why they should not be as the present trend is for simplicity, but it should be simplicity with refinement. At the same time they must bear some relationship in values to other pieces of furniture in the same room. For instance, a man does not put a deal table in his dining room, although for all practical purposes it would fulfil his requirements. Then why should he content himself with a cheap and rubbishy fitting because it gives him the necessary light required?

Unfortunately for the manufacturers, lighting fittings are generally the last things to be considered, usually after the client has overspent on his house and furnishings, and this doubtless accounts very largely for the low standard which is all too apparent in these days. It is not always a question of money, however, sometimes it is a lack of understanding.

The decorative value of the fitting cannot be emphasised too strongly. When it is switched on it at once becomes a centre of attraction and is much more conspicuous than many pieces of furniture in the same room upon which a great deal more money has been spent. How important it is then that it should be suitable for, and worthy of, its surroundings!

It is here that the contractor might do more to assist the fittings manufacturer. The client should not be left to wander about and select fittings without expert advice. If he does the chances are that he will purchase on price and without any regard at all to the suitability of the design. One not infrequently sees fittings of a cheap and poor quality in rooms lavishly and expensively furnished, which suggests that they have been purchased without any regard for their suitability to the positions they were to occupy.

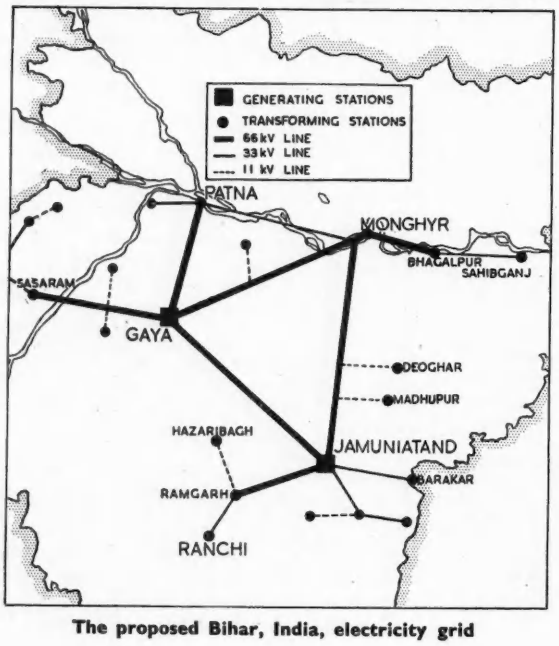
Interior decorators seldom leave their clients to their own devices but invariably accompany them to the manufacturer's showroom. When this is done price is not necessarily the determining factor, but some regard is paid to the suitability of the design, with the result that a fitting worthy of the position it is to occupy is purchased. If contractors were to follow the interior decorators' example and guide their clients into the right channels there would be fewer cheap and nasty fittings in evidence.

After all, the installation is often judged—too often perhaps—by what actually can be seen, and shoddy and unsuitable fittings give a wrong impression of the electrical contractor's work.

Bihar Grid Scheme

THE present scheme for an electricity grid in Bihar (India), states the *Indian and Eastern Engineer*, aims at developing South Bihar where fields are dry at the critical periods of growth of the crops, and of Chota Nagpur, which enjoys almost the monopoly of mica and shellac for the whole world. Also there is good industrial load in the collieries. The production of power in North Bihar remains under investigation.

Seventy-five per cent. of the United Provinces grid load is agricultural, but just the reverse is contemplated in Bihar, and this is confirmed by the report of the special officer-in-charge of electrification. The agricultural load will consist mainly of tubewells. The number at first will be about 500, rising to 900 in the fifth year of operation and costing about Rs.7,000 per tubewell. Besides the agricultural load of 4,125 kW, an immediate industrial load of 12,900 kW is anticipated.



The proposed Bihar, India, electricity grid

Two steam power stations, one at Jamuniatand and the other at Gaya, are proposed. The Jamuniatand station will have a total capacity of 20,000 kW and will be situated almost midway between the mica and the coal industries. The Gaya station, which will have a capacity of 15,000 kW, is centrally located in an almost ideal place with all transport facilities. The total expenditure incurred on both the power stations will be about Rs.62.86 lacs, inclusive of about Rs.11.85 lacs for contingency and establishment charges, &c.

The highest voltage proposed for the present is 66 kV, and the lines will follow the railway route as far as possible. The total route mileage will rise to 3,289 in the fifth year of operation. The entire transmission cost in the beginning will be Rs.1,39,72,800, i.e., Rs.5,850 per mile.

At present an experimental line from Dehri to Kudra *via* Sasaram has been approved and civil engineers are busy surveying the land. Electric power for this line will be taken from the 12,000-kW central power station of Rohtas Industries, Dalmianagar.

Record Sales at Aberdeen

THE Electricity Department of Aberdeen Corporation has established a new record. It is able to report an increase of over nine million kWh in the sales of electricity during the past year, substantially the largest in the history of the department. Mr. Alexander Gardner, the city electrical engineer, in his report for the past twelve months which will be presented to the first meeting of the Town Council in September, states that the total energy sold, 78 million kWh, represents an increase of 13 per cent. The advance in domestic consumption is indicated by the increase of 24 per cent. under the domestic tariff.

The engineer observes that sales for tramway purposes continue to increase, and points out that apart from other considerations it is an advantage to the city and in the interest of national economy that the most important transport routes in the town should be independent of foreign fuel. The maximum demand on the system last year was 29,780 kW and the load factor 36.56 per cent. The income of the Department was 307,432, compared with 281,514 in the previous year. Working expenses, at £176,208, were up by £13,384. The profit on the year's working, £14,700, was £209 less than in the previous year, but Mr. Gardner says this can be considered quite satisfactory in view of the increase in wages to all employés and the upward tendency in the cost of materials.

New consumers during the year numbered 2,828, making the total 41,886 including 12,767 on the domestic tariff.

LIGHTING TRENDS

Architectural and Decorative Aspects of Illumination

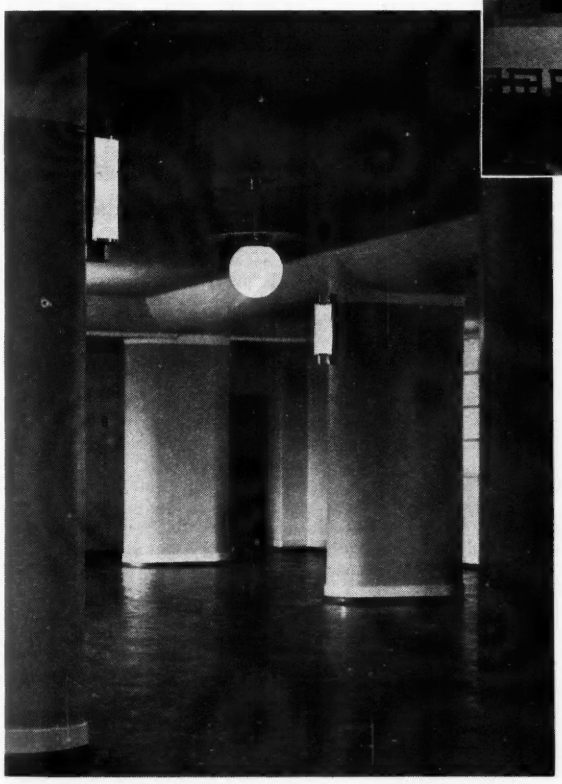
By A. B. Read, A.R.C.A.

TRENDS in design suggest gradual changes and in surveying the general development in the design of lighting and lighting fittings it is necessary to make comparisons spread over fairly long periods. As with the motor car there seem minor changes in design each year, yet a glance at models only a few years old shows clearly what real changes are taking place, and although we cannot forecast on this basis of past comparison it prepares us to accept revolutionary changes not only in appearance but in underlying principles.

A great deal has been written about the imitative stages that seem common to all evolution and progress. In the same way as the motor car and the railway engine were horseless carriages and have taken many years to shake off difficulties that have been put in the way of normal logical development, so in lighting the change from earlier illuminants such as candles, oil and gas have prejudiced the straightforward solution of contemporary lighting problems.

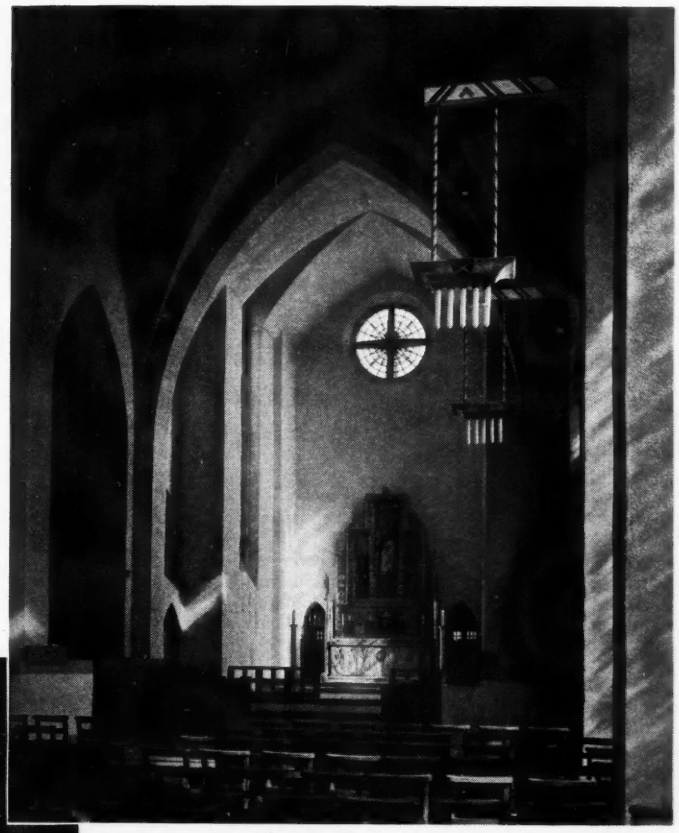
Efficiency and Pleasing Effect

There are also so many applications that have produced their own special technique, and lighting needs vary so considerably, that it is necessary to limit the scope of this article to what has been called for want of a better term, "decorative" lighting. Decorative lighting covers every kind of lighting other than the 100 per cent. functional kind that is desirable for completely utilitarian purposes such as factories and other similar buildings. In practically every building lighting to be efficient must be pleasing not only in its quality, but emanate from sources that are neither attempting to look traditional nor striving to be modernistic. A decorative quality in design does not imply elaboration and is often produced by restraint and simplicity.



To determine the main tendencies in lighting to-day is a difficult problem, but there is certainly one quality that is becoming almost universal and that is a dignified simplicity. For many years the theory that good solutions produce a purposeful beauty has been argued by many designers and societies promoting better relations between the artist and industry.

In spite of spasmodic changes in fashion and prejudice resulting from modernism blatantly and vulgarly exploited, there has been a very sustained and widely appreciated move-



Dignified simplicity is exemplified by these examples of modern lighting. Above: St. Thomas-the-Apostle Church, Hanwell. Left: Royal Masonic Hospital, Ravenscourt Park

ment towards simplification not achieved at the expense of beauty, but by the revelation of simple beautiful forms free from unnecessary and unworthy embellishment. This applies not only to lighting fittings and the general treatment of the best contemporary architecture and interior decoration, but to almost every article in common use, including the motor car, the telephone, kitchen equipment, particularly electrical accessories and a whole host of small containers and other things that can be bought for a few pence.

Simple Enclosed Units

It is refreshing to look through the architectural and electrical papers and find excellently designed buildings like schools and so on where at last simple enclosed lighting units are being widely used, taking their place neatly and appropriately in simple, efficient but nevertheless, extremely satisfactory interiors. This, after all, is a trend that started many years ago and has now become an accepted practice that will probably continue for a number of years.

Another functional principle in lighting that is being quite extensively used is the louvre method. Design of fittings for this purpose has been dictated only by actual requirements of illumination linked with the wholly admirable practice of designing interiors relative to the form of lighting equipment to be employed. In this way quite utilitarian units properly grouped for good lighting can be linked with the plan of the room and the purpose of the setting.

The provision of high-intensity lighting over the working

plane or display areas can only be achieved economically by units giving direct light, and the louvres provide the means of obtaining this result while protecting the eye from seeing the brilliant lamp source from normal viewpoints. There is no doubt that in spite of many other ways of lighting there is a tremendous future in this direction and there are innumerable opportunities of employing the louvre principle for the lighting of showrooms where light on counters and displays is of primary importance and for schools and offices where good lighting without glare is essential. The principle has also been adapted for the lighting of passenger coaches both in England and America. In addition it has great possibilities in the combination of efficient lighting with considerable decorative effect.

The trend in the direction of lighting by louvres has been accelerated by the unsettled state of international affairs that makes the dropping of bombs a possibility and the elimination of glassware from lighting fittings desirable.

There also seem to be two quite independent developments in lighting that produce quite characteristic interior planning and form. With the tungsten lamp there has been less use of concealed lighting from continuous cornices and other features, while its place is now being taken by the electric discharge tube in its many new forms. The tungsten lamp by its very shape is not easily adaptable for continuous lighting except in large cornices where spotting is avoided, while the continuous tubes that are now becoming widely used are obviously suitable for such positions. Where ordinary lamps are used there has been a return to a definite lighting fitting often recessed or semi-recessed into plaster coves and the main reason for this very logical development has been an economic one.

In spite of low charges for electricity there is a real desire for reasonable economy and instead of burying hundreds of lamps to produce indirect lighting which necessitates heavy loadings, fittings have been adapted to combine efficiency with effectiveness. Maintenance and a number of other important considerations have helped this, and the many excellent examples of direct methods of lighting that can be seen in buildings to-day are sufficient indication of the soundness of the principle employed.

Discharge Lighting

Lighting from discharge tubes has again opened up possibilities of economy in running costs and of high light output for small energy consumption. Apart from economic considerations, however, there are the endless variations in colour and colour combinations that can be employed in comparatively small spaces. As the light is continuous practically all difficulties of spotting, which are inevitable with concealed light sources, are absent.

Many years ago when so-called architectural lighting became widely used there was romantic talk of lighting from luminous sources, and certainly the effects produced now and the developments that are likely in the future go a long way towards producing this result. Whether surfaces of ceilings and walls will be linked with the fluorescent characteristics of this method of lighting is pure conjecture, but it does seem a possibility that general lighting with an infinite variety of intensity, quality and colour, will form, as it were, the surfaces of many interiors.

Electricity and Transport

Discussions at New York Conference

AMONG the papers submitted at the summer meeting of the Institution of Mechanical Engineers which is being held this week (September 5th-8th) in New York were contributions dealing with the construction of ships, rolling stock for steam and electric railways, passenger carrying road vehicles and flying boats.

Mr. S. B. Freeman, chief superintendent engineer, Alfred Holt & Co., points out in his paper that more than half the mechanically driven ships in the world are fitted with oil engines and that few steamships are being built. The outstanding factors in deciding whether coal or oil fuel shall be used are, he says, bunker space and weight.

He explains that with turbo-electric plant greater steam economy is attainable, due to the higher blade speeds, even when working at less than full power. There is also the possibility of obtaining full power when manœuvring astern, the saving due to dispensing with an astern turbine and the use of short steam pipes and shafting, the elimination of risk of damage by transmitting shocks from the propeller to the turbine, and the lessened vibration and noise in comparison with mechanical gearing. Against these must be set the lesser efficiency due to electrical losses, say, 9 to 12 per cent., and the increased initial cost.

The question of comparative weights and spaces occupied depends upon the type of machinery selected. Diesel-electric proposals now cover both DC and AC systems, and the latest of the latter type envisage the employment of multiple sets running at 1,500 RPM or even higher. In such cases the weight and space would compare favourably with any direct system of drive. While the cost of upkeep of fast-running oil engines might be high, the electrical plant needs little or no repairs.

Cargo Handling Plant

It is obviously unwise to run ships at high speeds from port to port and then to detain them unduly while loading and discharging cargo after arrival. The problem of supplying adequate and suitable cargo handling plant is as important as that of the propelling machinery.

The older classes of steamships are usually fitted with winches supplied with steam from an auxiliary boiler. Modern steamships use high-pressure steam and motor ships usually have electric winches. The power and speed of these two types are about the same. The first cost of electrical equipment will be about five times as much as that of steam plant.

The fuel consumed in the steam boiler, including lighting-up and standby losses, will be anything from six to ten times that of the electric winch supplied from the ship's auxiliary engines. Furthermore, the absence of the heat from steam pipes on deck, which affects the life and condition of the plating of the deck houses, casings, hatch coamings, winch pipe covers and steel decks, is a weighty factor in favour of electric power, the upkeep costs being greatly lessened by this arrangement. The steam winch has the advantages of being cheaper than the electric winch, the speed can be varied to a much greater degree and it can be stalled without wasting energy.

The electric winch is free from vibration and almost noiseless, a great advantage in passenger ships, and the features of a steam winch can be closely copied. A satisfactory electric winch must be robust, watertight, yet fully ventilated for tropical conditions, and all parts should be standardised.

Railway Coach Welding

A paper by Mr. W. A. Stanier, chief mechanical and electrical engineer, L.M. & S. Railway, is concerned with lightweight passenger rolling stock. He describes how constructional electric welding has assisted both in underframes and the body work of main-line coaches and the latest form of design for the Liverpool-Southport and Euston-Watford electrified lines.

A method of unit assembly has been adopted and both spot and arc welding are largely utilised, primarily to reduce weight without sacrificing strength. Particulars are given of savings in weight, but not of relative costs, which were not the prime consideration. The locating jigs and various types of welding equipment employed are described at some length, including an automatic machine with provision for variable and reversible rotation of the carbon arc.

Three cars per week have been built on the principles outlined without elaborate presses or machines.

Road Vehicles

Mr. E. C. Ottaway, technical officer (buses and coaches) with the London Passenger Transport Board, in his paper, which mentions administration but is largely concerned with engineering design, contends that for urban traffic the relative merits of omnibus, tramcar, trolley-bus and railway are complementary in some cases and possess individual superiority in others. In very large cities railways are found where the traffic is dense and the greatest capital expenditure may be borne; trams, trolley-buses and motor-buses are used where a compromise must be sought, and buses alone prevail where changing conditions and smaller traffic necessitate prudence in capital outlay.

The trolley-bus, which is free from noise and also runs smoothly on pneumatic tyres, is being largely used for the replacement of trams, and in some instances, where routes and conditions are established, is being extended beyond the limits of the previous tram tracks. It is the trolley-bus, with its readily apparent virtues but hidden vices of relative inflexibility and higher capital expenditure, which has now in turn become the standard for appraisement of the bus. There are still some 8,000 tramcars in the British Isles whose fate is sealed, but whose heritage will be disputed between these rival contestants.

MEASURING LIGHT

Recent Developments in Photometry

By John W. T. Walsh, M.A., D.Sc., M.I.E.E.

The author mentions the probable adoption of a new "black body" form of primary standard for the measurement of illuminants, which he describes. Other recently developed methods and equipment for gauging light values are reviewed.

TO the lighting engineer the most important photometric measurements are those of candle-power, luminous flux and illumination. The first two supply him with the data on which to base his calculations; the last provides him with a check on the results. Every measurement must be made in terms of some unit and this unit must be realised in material form by means of a standard. If possible, the standard should be reproducible from specification and it is here that a considerable advance has been made in photometry during the last few years.

The first standards of light to be used were candles of specified size and composition and later these were superseded by more reproducible flame standards, notably the Vernon-Harcourt pentane lamp in this country and the Hefner lamp in Germany. Matters remained at this stage for a time, but soon after the advent of the carbon-filament electric lamp it was found that the lamps to be measured could be compared with each other and would maintain their relative values of candle-power to a much higher accuracy than that with which the flame standards could be reproduced. In consequence these standards gradually fell into disuse and for some considerable time past the unit of candle-power has been preserved solely by means of certain electric lamps kept at the various national laboratories.

Thus there is no primary standard of light in existence at present. It is probable, however, that this unsatisfactory state of affairs will be brought to an end next year, for the Comité International des Poids et Mésures has recently adopted a primary standard in the form of a "black body" radiator at a specified temperature. This form of standard was originally proposed many years ago but it is only comparatively recently that it has been found possible to realise it with the necessary degree of reproducibility.

Dr. Walsh is at the National Physical Laboratory

New Standard

A "black body" radiator consists, essentially, of a small aperture in a hollow enclosure maintained at a uniform temperature and the brightness of the aperture of such a radiator is completely defined by the temperature of the enclosure. The new primary standard consists of a black body radiator at the temperature of solidification of molten platinum and the unit of candle-power adopted by the C.I.P.M. is of such a magnitude that the brightness of the black body at this temperature is 60 units per sq. cm. It is known that this unit is very nearly the same as the unit of candle-power in general use at the present time.

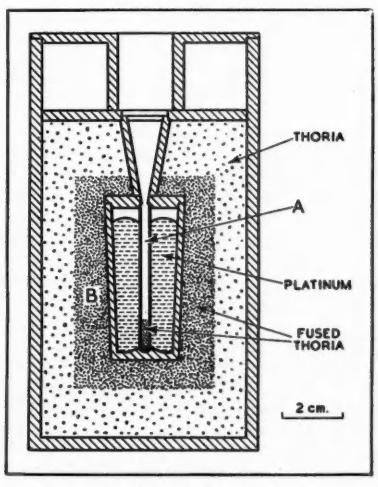


Fig. 1—The "black body" standard of light

The general form of the standard is shown in Fig. 1. The central tube A, made of fused thoria, is immersed in platinum contained in a thoria crucible B. This crucible is enclosed in a container filled with powdered thoria and the whole is placed in a high-frequency induction furnace. The current induced in the platinum, which acts as the secondary circuit of a transformer, is sufficient to melt it. The tube A is the black body and the small hole in the lid of the crucible is the aperture. An enlarged image of this hole is formed on a photometer screen by means of a lens and prism and the platinum in the crucible is first melted and then allowed to cool very slowly. As soon as the metal begins to solidify the temperature of the tube remains very constant and the brightness of the image on the photometer screen during this period can be used to standardise a suitable lamp by the usual substitution method of photometry. The brightness of the image is, of course, calculated from that of the aperture, allowing for the absorption factor of the lens and prism, a factor which has to be determined independently.

Photoelectric Photometry

In the measurement of candle-power or luminous flux, the outstanding advance that has taken place within the last ten or fifteen years is the very extensive replacement of visual methods of photometry by the use of photocells. For the routine measurement of filament lamps, for instance to check compliance with a British Standard Specification, it is the value of luminous flux that is generally required. The lamps are placed one after another, in a spherical integrator, usually about 3 ft. in diameter, and outside the diffusing window of the sphere there is a light-tight box containing a photocell. Sometimes this cell is of the "emission" type in which the sensitive surface (of alkali metal) is enclosed in a glass bulb and the current measured is that which passes through the cell when a voltage of the order of 30 to 60 is applied to it from a storage battery. Sometimes the cell used is of the "rectifier" type, consisting of a flat disc of iron coated with selenium. This form of cell gives a minute current when illuminated, without the need for any external battery.

Since a photocell by itself does not imitate the eye in its relative response to lights of different colours, one of two alternative methods must always be employed in photoelectric photometry. In one procedure the difference of colour is avoided altogether by using as substandard a lamp of the same general type as the lamps under test. This sub-standard is measured independently by some more fundamental method. In the other procedure the cell is "corrected" by means of a colour filter so designed that the colour sensitivity of the cell-filter combination is very closely similar to that of the eye.

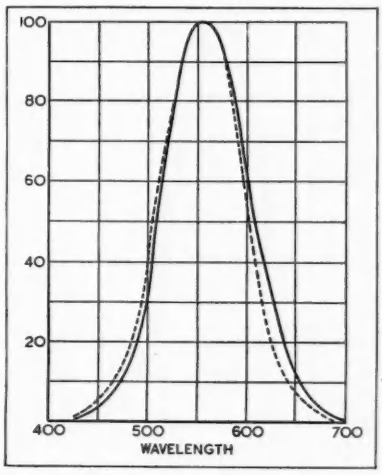


Fig. 2—Sensitivity curves of the eye (full line) and a corrected photocell (broken line)

Fig. 2 shows what degree of correction can be achieved by the use of a fairly simple colour filter. The full-line curve is the spectral sensitivity curve of the eye, the broken line that of the cell-filter combination, the cell in this case being of the emission type.

Photometric Integrators and Illuminometers

In visual photometry there has been very little change, except in matters of detail, for some considerable time past, but it is worth noting that in connection with the measurement of luminous flux, visually or photoelectrically, a method has been devised by which an integrator, either spherical or cubical in form, may be used for measurements on fittings, &c., which are large compared with the integrator. For instance, a 12-in. reflector fitting may be measured in a 28-in. cube. A brief description was given in *Light and Lighting* for 1936 (vol. 29, p. 167).

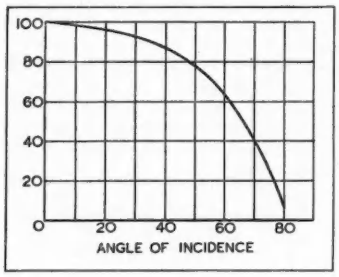


Fig. 3—Variation of sensitivity of photocell with angle of incidence of light

The determination of the candle-power distribution from large lighting fittings, especially those used for street lighting, has become more and more frequent owing to the recent rapid growth of interest in public lighting. Many fittings have an asymmetric light distribution so that the old form of simple polar curve has to be replaced by an iso-candle diagram giving a graphical representation of the candle-power distribution in all directions in space instead of in one plane only.

The measurement of illumination has become increasingly important during the last few years, and it is fortunate that the use of photocells has made possible the production of illuminometers which are much handier than the older types of visual instrument, not only because they require no auxiliary battery but also because, to the unpractised observer, reading a scale is simpler than making a photometric setting. The cells used are of the rectifier type and the instrument consists simply of a holder containing one or more cells connected to a portable micrometer.

Since a single cell of the size and type usually employed gives a current of about 2 to 6 μA when the illumination is one foot-candle, it will be seen that a major problem in the design of any photoelectric illuminometer is the measurement of such small currents to a sufficient degree of accuracy for practical purposes, using an instrument of adequate robustness and portability. It is for this reason that illuminometers intended for the measurement of illuminations below about 2 or 3 ft.-candles usually have two or more photocells connected in parallel.

Although, as stated above, to anyone not practised in photometry the photoelectric illuminometer appears a very much simpler instrument than the visual photometer, to a certain extent this very simplicity is a potential danger. Provided there is some illumination on the cell the instrument always gives a reading but, unless care is taken to avoid the various possible sources of error, the reading may differ from the true value of the illumination by a very large percentage. The chief sources of error likely to be overlooked are (i) the effect of the angle at which the light reaches the photocell, and (ii) the effect of the colour of the light.

Fig. 3 shows how the sensitivity of a rectifier photocell may fall off as the angle of incidence of the light reaching it increases. For this reason it has been recommended* that "readings should be made with light incident on the light-sensitive surface at angles less than 35 deg. from the normal, unless there is evidence that the cell in question is sufficiently accurate at higher angles of incidence."

It has already been pointed out that a photocell cannot be used for comparing lights of different colours unless it is corrected by means of a colour filter. The use of such a filter in an illuminometer has the disadvantage that it still further reduces the current corresponding to a given illumination. It is therefore usual for the makers of instruments intended for measuring the illumination from such sources as sodium or mercury-vapour discharge lamps to provide multiplying factors which have to be applied to the readings obtained when the light is of a different colour from that for which the instrument was calibrated.

Discharge Lamps

It is not only in the photoelectric measurement of illumination that the advent of the discharge lamp has brought into prominence, and in a very acute form, one of the oldest problems of photometry, viz., the quantitative comparison of lights differing markedly in colour. The determination of the candle-power or luminous flux of a discharge lamp is probably the most difficult measurement called for in practical photometry at the present time. Where visual methods are employed the colour difference between the test lamp and the sub-standard (usually a tungsten filament lamp) is generally overcome by using a colour filter which, placed in front of the sub-standard, gives an approximate colour match with the discharge lamp. The transmission factor of this filter is determined independently, using a spectrophotometer.

This solution of the problem is by no means completely satisfactory. In the first place the colour match is never perfect, and secondly, it is only a "sensation" match and the energy distributions of the lights being compared are very different. As a result, different observers obtain results which often show a considerable lack of agreement. The flicker photometer is sometimes used, but the conditions of observation then have to be very carefully specified and the work is much more tedious and tiring than ordinary visual photometry. For routine work it is probable that photoelectric methods will be generally employed.

* "Recommendations Concerning the Use of Portable Photometers, Particularly for Street Lighting Measurements." Trans: Illum. Eng. Soc. (London). Vol. 2, 1937, p. 63.

A.R.P. Lighting

Ways of Meeting Wartime Conditions

FOR some time past advances in the technique of applying correct illumination principles have to some extent been subordinated to the need to provide against possible attacks from the air. Thus, in the Fourth Report of the Departmental Committee on Lighting in Factories, issued last November, regrets were expressed on account of the present necessity for securing adequate precautionary measures against air attack.

While finding it impracticable to make recommendations of general application to the diverse conditions of industry the Committee drew attention to the need to provide minimum essential lighting totally screened from observation from the air with centralised control and adequately screened local sources at key positions in order to carry on work during hours of darkness. One example of this enforced departure from civilised technical and commercial considerations is that the construction of glass-walled power stations with its effect on their general lighting arrangements is no longer practicable.

The appearance of our streets after nightfall now shows that all the advantages brought by the discovery of discharge lamps have had to be given up. Indeed, we have, for the time being, gone back a good deal farther even than the pre-electric era.

On the other hand, the discharge lamp in the form of the recently developed "black lamp" has come along in time to be useful in A.R.P. work in power stations and sub-stations, as was shown by Mr. R. H. Finch in our issue of August 25th. Its light is invisible from above, but the ultra-violet rays it emits can be used to excite fluorescent powders on various items of apparatus, which can thereby be operated safely in darkness.

Presumably an even horizontal illumination on the ground level of 0.002 ft.-candle, with no measurable light emission above 5 deg. below the horizontal, is the maximum permissible for outdoor use, to judge from the new British Standard Specification (A.R.P. Series) No. BS/ARP 16, which was reviewed in our last issue, although, in the view of the Joint Committee of the Illuminating Engineering Society and the Home Office A.R.P. Department, this value may in certain circumstances be increased to 0.02 ft.-candle if the light can be immediately extinguished in emergency. For this purpose special fittings of iron or aluminium (known as IES/ARP. 002) with reflectors treated on the interior surfaces with matt paint are obtainable for housing a 15-W internally frosted lamp. The shades are suitable for use with standard bayonet-cap holders (BS52), so that the fitting as a whole (which must be maintained in a vertical position) may be inserted in an existing holder. The spacing between fittings must be not less than four times the

mounting height above the ground which varies from 10 to 20 ft.

While streets will be for a while without well-lighted shop windows, which have become so increasingly a feature of attraction in our urban areas by night, that does not mean that the shops themselves need be without plenty of light, so long as the light is not thrown on to the street when customers enter or leave. This can easily be guarded against, on the principle that light rays cannot go round corners. A simple light lock has been standardised (BS/ARP 15) which is based upon the use of two right angled turns. Subdued lighting within the lock itself is permissible and desirable and 0.02 ft.-candle in a fitting designed to hold a shielded 15-W lamp in accordance with a shortly forthcoming Specification BS/ARP 20 is recommended. Partly in order to diminish the entry of strong light into the lock and partly in order to avoid too great a contrast between the lighting of the shop and the lock, sources of light close to the entrance should be shielded.

This is a better way than the alternative suggested of an aperture covered by translucent material in the wall of the lock at a point half-way between the two entrances. The adoption of this method would, however, permit of the installation of a sign illuminated by transmitted light and carrying black or white letters on a blue ground indicating the name of the shop. The dimensions of the sign should not exceed 20 by 15 in. and it should not transmit more than 10 per cent. of the light impinging on it. If used it should be placed in the passage wall facing the main entrance to the shop. The light lock should extend to the ceiling, unless the ceiling is blackened throughout, but in no case should it be less than 7 ft. high. Any step downs with cautionary notices should be painted in white.

The walls and ceiling of the light lock must be painted a dull black and two continuous 2-in. white lines, one at 3 ft. 6 in. high and the other at 2 ft. 6 in. should be drawn horizontally along the walls.

Hand Lamps

Hand lamps are likely to be much in demand. In some cases they may be required for general use out of doors in all sorts of weathers or in buildings in which the windows or rooflights are not screened. The ordinary electric torch will not do for such purposes, but the type of hand-lamp designed in accordance with BS/ARP3 should meet all normal requirements in this way, except where inflammable gas or vapours are present. In its general construction, the battery, bulb and switch are housed in one unit, preferably with provision for a spare bulb which, with the battery, should be capable of quick replacement. The outfit is intended to be strapped or hooked to the chest (not the head) of the person carrying it, so as to leave both hands free. The switch should have "on" and "off" positions and, while capable of operation by a simple movement, should be designed as far as possible to prevent inadvertent operation. Devices for varying the intensity of the light or its focusing during use or its extinction if inverted should not be incorporated.

Either a dry-cell or an unspillable accumulator may be employed; in the first case the closed-circuit voltage should not fall to less than two-thirds of the initial open-circuit voltage after six hours of continuous operation and in the second the light output should be maintained without material diminution after not less than six hours of continuous operation. The light must be white. When the lamp is in its normal operating position 4 ft. above the ground, no direct light from any part of the lamp (including any reflector) ought to be visible at any point more than 3 ft. above the ground at a distance of 10 ft. from the lamp, but no moveable shutters or screens are to be fitted. With the lamp in this position, the intensity of the light emitted at all angles up to 60 deg. from the vertical must not be less than ½ c.p. in the forward direction and not less than ¼ c.p. at all angles within 45 deg., measured horizontally, of the forward direction. The maximum intensity permissible of the light emitted is 1 c.p.

Proposed Legal Minima

Another aspect of lighting in war time is the illumination of public air-raid shelters, with battery standby. This forms the subject of a further British Standard Specification, BS/ARP 6, which was dealt with in our last issue.

As a measure of what lighting restrictions mean, under the Factory Act, 1937, the proposed legal minimum (which does not necessarily represent what can be regarded as good practice) is 1.0 ft.-candle at floor level for general illumination, apart from the higher standard required on the bench for the work itself. For places like corridors, stairways and stores the lower value of 0.5 ft.-candle is permissible, while for open yards without dangerous places 0.1 ft.-candle will be tolerated. Even the last is fifty times the 0.002 ft.-candle prescribed.

In view of its very great importance at the present time we repeat the conclusions reached by the I.E.E. and A.R.P. Department Joint Committee regarding factory lighting which we published last week. This was that "effective and adequate illumination for the carrying on of work in factories is only practicable on the assumption that means are provided to screen completely, by opaque materials, any visible upward and outward emission of light through the windows of the buildings." This recommendation will be reviewed when the results of investigations being made into the possible use of "complementary light" are completed. In this system the illuminant is restricted to a certain distinctive colour while the window has a coating of a complementary colour.

Mines and Quarries

Exterior lighting must be dispensed with at collieries, metalliferous mines and quarries, except where the use of a limited amount may be authorised on the grounds of national importance. The Mines Department requires that the intensity of outdoor lights shall not exceed certain values that fall within three groups. In the first of these, Standard B, the intensity does not exceed 0.002 ft.-candle at any point in the area illuminated. This is the only one that will generally be permitted, e.g., over uncovered tub or wagon roads and means of access.

Standard B1, 0.02 ft.-candle, may be used in any part of the premises which is roofed over with open sides, e.g., at the pithead, in boiler houses or along covered roadways, provided reflectors are arranged to prevent any part of the light source from being seen above the horizontal. Light should not be permitted to fall outside the roofed area on to uncovered ground. The extent of the lighting is therefore governed by that of the roofing, and in the case of uncovered or partly covered pitheads, temporary roofing or partial enclosure of the sides may be necessary. Railway siding illumination should generally not exceed Standard B, but where essential B1 may be allowed, even when there is no roofing. Where enclosure is complete with side walls, Standard C, 0.2 ft.-candle, is advised.

Interior Lighting

Obscuration of necessary interior lighting will follow the lines laid down in A.R.P. handbook "Wartime Lighting Restrictions for Industrial and Commercial Premises." In power houses and winding and pumping houses where such obscuration is impracticable, general lighting may be dispensed with, and dim, well-shaded lamps only provided for the illumination of switchgear and engine controls. Winding engine indicator markings may be treated with fluorescent paint activated by ultra-violet light.

Ordinary lamps of from 15 to 60 W with m.s.c.p. of from 9.5 to 49 may be used. For collieries and metalliferous mines where the reflector is blackened, the c.p. of the lamp should be the square of the mounting height in feet multiplied by the intensity permissible under standards B, B1 and C; if the reflector is white the c.p. so derived should be halved. For quarries somewhat similar values are tabulated. The part of the bulb below the filament may be silvered or painted with opaque paint to avoid pools of light below the fittings, particularly at low mounting heights. Orange, red or green lamps should be avoided. Coloured lamps should be internally sprayed, and the treatment of existing bulbs by dipping in paint is inadvisable.

Where these standards are permitted, illumination must be limited to the minimum area essential to the carrying out of the work and all lamps and fittings must be shaded so that no direct light is visible above the horizontal. Reflection from light coloured surfaces or from water should be avoided, and reflecting powers of surfaces should be reduced in the lighted areas. White paint, for example, may reflect twenty times as much light as black paint or tarpaulin. Small areas of white paint or limewash may, however, be used to facilitate observation of details. The interior tops of reflectors should be blackened and the skirts left whitened in order to distribute light over the maximum area.

It is a condition of the use of Standards B1 and C that all lighting can be extinguished within one minute of an air-raid warning and a responsible person must be continuously in charge.

The Mines Department regards these requirements, stringent as they are in some respects, as imperative in time of war. It states, however, that any details that are found to present special difficulties may be subject to further consideration in consultation with the A.R.P. Department. Expenditure on the necessary measures will normally be admissible as a deduction in computing trading profits for income tax purposes, as indicated in paragraphs 21 to 23 of the memorandum entitled "Air Raid Precautions in Mines and Quarries: Civil Defence Act, 1939."

THE "COLD SNAP"

I.M.E.A. Approaches Central Board

LAST December's cold spell, it will be remembered, perturbed many undertakings whose maximum demand was considerably increased by the switching on of large numbers of heaters, and who regarded with apprehension the effect upon the fixed charges for their supplies from the grid.

Some of them made representations to the Incorporated Municipal Electrical Association which took the matter up with the Central Electricity Board. According to the *I.M.E.A. Journal*, it was not suggested that the Board should waive the increase on the kilowatt charge but, that owing to the adverse effect on the finances of certain undertakings in that year, some method might be found for spreading the increased charges over a period of years.

The representatives of the Board said that it appeared that undertakers purchasing their supplies at the tariff were not unanimous in the opinion that any adjustment of the kilowatt charge should be made, indeed, amongst others, the undertaker who purchased the largest grid tariffs supplies had expressed the view that no adjustment should be made. The Board had, nevertheless, given the matter very careful consideration and had dealt with the salient considerations in its annual report for 1938.

In amplification of what was said in that report it was pointed out that, at 180 grid points, undertakers purchased their supplies at grid tariff or other fixed price. Those undertakers were required to give notice to the Board at the beginning of each year of their anticipated demand on the Board in the following December. Of the 180 undertakers the actual maximum demand of 90 of them exceeded their estimate, the maximum demand of 86 fell short of their estimate and the actual demand of 4 was the same as their estimate. In total the estimated demand of all those undertakers was 1,282,000 kW, while the actual recorded demands exceeded that figure by only some 27,000 kW, which represented just over 2 per cent. and the additional revenue accruing to the Board therefrom amounted to about £75,000 which again represented about 2 per cent. of the total kilowatt charges.

On the legal aspect the Board was advised that it is not empowered to discriminate and adjust the kilowatt charge payable by one undertaker and not by all.

Grid Finance

The Association representatives were reminded that the Board's grid tariffs had been fixed over a budgetary period of ten years and, if in some years the undertakers experienced a higher demand than they had anticipated, it was equally true that in other years their demand on the Board was lower than they expected; for instance, in 1934 and 1936 abnormally mild winters were experienced with the result that the demands on the Board fell below expectations. Nevertheless, the Board had to make its arrangements for the installation of sufficient generating plant and other equipment to deal with the anticipated demands and it was one of the benefits to undertakers who purchased their supplies at the grid tariff that, although their maximum demand at the end of some year might be more than that which they anticipated at the beginning of the year, there were other years in which the converse held and in respect of these years they were not called upon to pay for the reserve plant which they would have had to provide had they generated their electricity requirements independently.

On the general question of the form of the grid tariff with the kilowatt charge which is based on the maximum demand taken by the undertaker in any half-hour in the four winter months, it was pointed out that this had been the subject of careful consideration by the Board before the grid tariffs were instituted and had since been reviewed. An undertaker whose load was predominantly domestic might be subject to material fluctuations in his demand according to the weather conditions which prevailed. The effect of the cold snap could be minimised in such cases were the kilowatt charge based on the average of the maximum demands recorded in any half-hour in each of the four winter months. If that basis had been adopted the kilowatt charge would, of course, have had to be increased and, although there was insufficient information available as to the frequency with which abnormally cold winters might be expected, it was probable that the adoption of that basis would have necessitated an increase in the basic and increment kilowatt charges in the tariff of say 10 per cent.

It seemed quite clear, however, that while such a basis might have been to the advantage of undertakers whose load was essentially for domestic purposes, it would have seriously handicapped those undertakers who catered largely for industrial or other loads which tended to remain constant from month to month. Moreover, it was emphasised that, if as a result of cold snaps the Board's revenue was substantially increased, then any surplus which might accrue must, of necessity, lead to an earlier general reduction in the Board's price for supplies of electricity, since it was not entitled to make profits.

The Board pointed out that difficulties arising out of a cold snap in any one year could be minimised, if municipal undertakers refrained from allocating the whole of their surplus each year, and instead carried forward an appropriate balance on revenue account for future contingencies.

In the Board's view cold snaps were not a new phenomenon with which the electricity supply undertakers had to deal. The policy of the industry in recent years in encouraging the wider use of electricity for domestic heating had, no doubt, tended to intensify the effect of cold snaps on the demand of the consumers in certain areas, but it had always been recognised that it was the duty of the undertakers to be prepared for such contingencies and regulate their retail tariff structures.

Restriction of Development

The Association's representatives stated that there was no doubt that the finances of a number of undertakers had been considerably affected by the cold snap last year and certain of them were definitely contemplating retarding the development of the domestic cooking and heating load. They suggested that perhaps the Board could make the kilowatt charge payable on the undertaker's estimated demands so that if there was a cold snap at the end of the year the undertakers would not be called upon to pay the kilowatt charge for abnormal demand thereby created.

The Board did not think this suggestion would work in practice because it carried with it as a corollary that, in a mild winter when the loads of the undertakers were lower than they expected, they would have to pay for the higher demand which they had anticipated; as a result there would be a strong inducement for undertakers always to notify a low anticipated demand in the knowledge that, if the estimate given was exceeded, the excess would not have to be paid for.

To retard the development of the cooker load because of the effect of the cold snap last winter appeared to be an illogical course because the most effective way of minimising the effect of increased demands due to the domestic heating load was to develop to the utmost all other types of domestic load so as to obtain the full benefit of diversity. The view was also expressed that the electric heaters which were purchased by consumers during the cold snap were now proving a benefit to the undertakers as they were being used and thereby consuming electricity at off-peak times.

Fibrous Glass Insulation

TEXTILE glass possesses the merit as an insulator of being inorganic. At present, however, its chief use is in combination with varnishes and resins, since by itself its electrical strength is too low for most purposes. In *Electrical Engineering* (the journal of the American I.E.E.) Messrs. A. Gemant and F. A. Glassow, who consider that eventually the ideal insulation will be textile glass impregnated with an inorganic resin of the future, give the results of their investigations into its electric strength when unimpregnated.

Their tests show its high qualities at high pressures and temperatures. The main conclusions of the authors are:—(1) The maximum breakdown voltages for AC are higher than for DC. (2) The density of the texture has not the same effect on the electric strength that it has in the case of paper, since the dimensions of the interspaces are much larger; further increase of the density would be desirable. (3) The electric strength increases linearly with pressure (measured up to 5 atm.), though the values are lower than those corresponding to an air gap of the same separation. (4) Measurements up to 350 deg. C. indicate satisfactory electric strength even at higher temperatures, although puncture values decrease with increasing temperature; heat treated and washed samples from which the small proportion of oil is removed prove superior at higher temperatures. (5) The leakage resistance (measured up to 160 deg. C.) is very satisfactory (10^{16} to 10^{13} ohm-cm), decreasing with increasing temperature in the usual manner, oil-free samples again proving superior to the untreated ones.

TRAINING FOR INDUSTRY

Discussions at the British Association Meeting

Dr. Fleming's Address

DESPITE the international situation the membership of the British Association for the Advancement of Science this year was over 3,000—the most ever recorded for Scotland and the most obtained anywhere for many years. Last week we gave an account of some of the earlier papers presented.

On September 1st, after the various sectional meetings had been completed in the morning and some which were to continue in the afternoon had been abandoned, the General Committee of the Association met and decided that in view of the serious international situation they had no alternative than to abandon the meeting as a whole. The Committee elected Sir Richard Gregory, Bt., F.R.S., as President for next year and an invitation to hold the meeting in Newcastle-on-Tyne in 1940 was accepted.

Vocational Guidance

Dr. A. P. M. Fleming delivered his presidential address to Section L—Education, on August 31st, his subject being "Education for Industry." Conditions in industry, he pointed out, were never static and the personnel must be adaptable to changes not only of a technical character, but also of organisation. The industrialist was apt to overlook the need for constant attention to the educational reactions of development, while those concerned with technical education might suffer from an unbalanced view as to the value of such education in relation to other industrial problems. Effective training for economic production meant in the broadest sense effective education for both manual and non-manual workers who were fitted to take the fullest advantage of it.

The evolution of industry involved a continual change in the character of the knowledge that must be applied by those engaged in it, if they were to achieve a continually increasing efficiency of production. How important this question of efficiency was to the whole community of an industrial nation might not always be appreciated.

The importance of vocational guidance in the early years could not be too highly stressed, and although good work was being done in this direction much more was needed; it should in fact be accepted as a responsibility by every competent teacher. Such acceptance implied familiarity with local conditions and opportunities. One useful adjunct might be the keeping, from school entry age onwards, of a record of the particular characteristics, aptitudes and preferences displayed by the pupil.

Management was of vital importance in ensuring continuity of progress in manufacturing concerns. It was essential that the selected men should be given preliminary and widely-applied responsibility before making use of such aids as the ancillary instruction now available in many technical institutions. Recruitment for research work in industry was another case in which the selection of personnel inherently suited for such work must be the basic factor. Methods of training research workers were beginning to evolve, but so far no recognised plan had been established.

Control of Practical Side

The conventional system of education was subject to control by national and local educational authorities, but there was no control over the equally important practical side of education for the industrial worker. No national means existed whereby a standard could be set for this phase of education, nor in fact were the resources for training in industry fully utilised. This weakness could be remedied only by more complete voluntary co-operation within industry. Control could be instituted by restricting the remission to courses approved by a suitably constituted authority.

An educational problem that was already acute and would be even more so in the future was the supply of suitable teaching staff for the universities and technical institutions. The practical industrial side of training was of paramount importance. In this connection co-operation should be arranged with industry to provide a suitable range of practical experience without the permanent absorption of the personnel so trained. The greater availability of technical scholarships and fellowships might well serve as a means of attracting suitable personnel to industrial employment. The extension of fellowship facilities available for those who sought experience abroad was extremely valuable.

As yet there was no clearly defined and assured path by which a youth could proceed through the various stages of education into industrial employment. The national system of education provided the means whereby those of suitable ability could obtain education and training up to and including the university or technical college level, but the practical training in industry and an assured start in a job was at present fortuitous. In this direction there was room for greater co-operation by industry to ensure the completion of the industrial training and a start in the chosen career.

Discussion

Mr. W. O. Lester Smith (Director of Education, Manchester), in a written contribution to the discussion, said that co-operation between industry, local authorities and teachers was of vital importance to industrial prosperity. The proposal in the Spens Report to transform junior technical schools into technical high schools might enhance or, it might be, impair the valuable work they were doing. Speaking of the disadvantages of evening class work, which was of an intensive nature, Mr. Lester Smith suggested it was time, both in the interests of youth and industry, that the State—as the Fisher Act intended—should provide continued daytime education and guidance for all young people. There were three ways of transmitting rapidly through technical education knowledge of new processes and the achievements of research, *viz.* (1) regional advisory committees; (2) more attention to the training of technical teachers, especially refresher courses, and (3) the appointment in every local authority area of any size of an organiser of technical education, able to keep in touch with local industry and know its needs in regard to new developments.

Dr. K. Fisher (Headmaster of Oundle School) said that a public school, and especially a boarding school, was the most favourable background for life in industry; from his own school 35-40 per cent. of the boys went into industry, either directly or indirectly. Mr. D. Shillan (University of London Institute of Education) said that when he visited the U.S.S.R. in 1932 there was a system of attaching every school corresponding to our own secondary school status to the nearest factory or firm and the boys went into the factory and were instructed on the plant as they found it, instead of being instructed on full size plants at school. During a recent visit to the U.S.S.R. he had found that a much more academic type of curriculum had been adopted.

University Engineering Courses

THE first paper in Section G (Engineering) was on "University Engineering Courses," by Prof. Willis Jackson, of the Electro-Technical Laboratories of the University of Manchester. Following Professor Southwell's statement last year that undergraduate courses in engineering science were in danger of becoming overcrowded and unduly specialised, to the detriment of their educational value, the Sectional Committee decided to implement his suggestion that the opinion of industrialists should be sought by undertaking an informal inquiry. Approaches were made to about fifty industrial and other concerns—civil, mechanical and electrical engineering. The total number of completed questionnaires received was about 650, and the inquiry concerned itself only with the university course. A great majority of the replies from industry were definitely against the idea of specialisation at the university. The graduates considered, in the main, a division into civil, mechanical and electrical groups as essential during the later stages of the course. Less than 20 per cent. considered that the degree course had been overcrowded.

Discussion

Dr. A. T. Bowden (Perth, W.A., University) gave details of the courses worked on the "sandwich" system, which produced perhaps not experts in any one single branch, but men with general intelligence and a certain cultural background, and with some knowledge of how to deal with men, which was gained during their two years' practical work.

Prof. Burstall had recently taken up the Professorship of Engineering in Melbourne and had instituted a three-year course, which was meeting with a great deal of criticism in Australia. It was instituted because Australia was becoming industrialised, but there were many who felt it was a retrograde step; he personally preferred his own five-year course, with two years' practical experience.

Prof. R. V. Southwell said that engineering education should be regarded as a three-year process. The work should be shared by the universities and industrialists, and could not be done by the universities alone. His own ideas were developing in the direction of lightening the syllabus, because the first need of industry was for what might be called "subalterns," good all-round men with personality and side interests. As regarded specialisation, in a three-year course he would not have boundaries between the different branches of engineering, because they could only be artificial. The students should then go into industry for practical training, and return to the university for some training in law, industrial organisation, &c.

Prof. A. R. Fulton (Dundee University) referred to the three-year courses at Dundee and Glasgow, and commented on their strenuous nature. The whole object was thorough groundwork in the fundamental principles, to enable the students to put those principles into operation when they had to face actual problems in industry later on.

Mr. H. E. Wimperis, president, said that when he was recruiting men for research work for the Air Ministry, as he did for a number of years, he did not choose only those who had obtained first-class degrees because he did not trust the universities always to distinguish between men with first- and second-class degrees. He wanted qualities other than those revealed by examination, such as leadership.

Mr. W. T. MacCall (Sunderland) said that there were differing opinions as to the application of "sandwich" schemes. His own scheme provided for six months in college and then six months in the works, but that was not now applied to the degree students.

Improving the "Sandwich" System

Prof. Southwell said he had not been thinking so much of courses as they were to-day, but as they might be planned for twenty years ahead. If there was a merging of responsibility between the universities and industry, he was hoping it might be possible to arrange something which would have the advantages, without the disadvantages, of the "sandwich" system. By going to a works before going to a university, a man artificially, so to speak, put himself in a specialised class earlier than was desirable in his own interests. If he could go out into industry after three years in the university, and then go back to the university, that would be ideal.

A speaker representing the Engineering Sub-Committee of the National Union of Students, said that the Union was in complete agreement with the paper. It had decided quite conclusively that it would like students to go into industry for six or twelve months before entering the university. In that way they would have an opportunity of appreciating responsibility and of developing their characters with the idea of becoming specialists. The Union had circulated the suggestion to the universities, who had replied that it was at too early a stage now to introduce it.

The author, in a brief reply, said that from his own observations the fourth year tended to degenerate into a specialised course within a particular branch of engineering. He knew of one case in which it was possible for a student to drop all mechanical engineering subjects and take up the specialised study of electrical machine design, electrical measurement, electric traction, electrical communications, or high voltage work, but that was quite contrary to anything that he personally would tolerate, and he believed his was a widespread view. While agreeing that the syllabus should be reduced to permit time for other things, he felt there was difficulty in doing it. Outside lectures ought to form an integral part of the course, but it was difficult to find the right men for this.

Technical Education

ON September 1st, Section L discussed the problems concerned with education in industry.

Mr. John B. Longmuir (of Messrs. Mavor & Coulson, Ltd., Glasgow) opened the discussion and emphasised the responsibility and obligation upon everyone who employed young workers. The narrow specific workshop or office training, he said, should be provided by the employer, but the responsibility for technical training should be shared with those responsible for education. With a few notable exceptions, there was no organised and systematic workshop training in Scotland, and technical education was equally unsatisfactory. There would be no real purpose until co-operation was effective and employers took more interest both in day school and technical education.

Mr. Longmuir advocated a bolder policy of grading, which would give the pupil free choice of a course suitable for his occupational desires. The fears of school staffs that if they talked to the boys about their future careers the boys would become unsettled were groundless; a boy with an objective was more educable than a boy with none. Few careers masters and mistresses knew enough about industry and commerce to be able to advise or give the necessary guidance. Juvenile Advisory Committees set up under the Ministry of Labour only made contact with the boy when he was leaving school, which was too late to be effective.

Education should be less bookish, and the attempt to convert all secondary schools into miniature universities should be stopped. The ideal would be to set up in every large city or town a junior technical school under a headmaster with the additional qualification of having earned his living outside education. Such a school would provide, in addition to the three years' course, a five years' course leading to a central institution. In time the University Entrance Board would have to accept such a school's certificate for entrance to a university. One traditional higher grade day school in each county, city or region would provide for the less than 10 per cent. who desired, or were capable of taking, a leaving certificate to enter an arts degree course at a university. The junior technical school would be the centre of evening continuation class education, and its courses would lead direct to continuation classes.

Mr. Longmuir stressed the employers' obligations for the technical education of young workers, the limitations of works schools, discussed the possibilities of introducing day continuation classes and said that we were behind some Continental countries in technical education.

Mr. G. L. Darbyshire (L.M.S. Railway), in a written communication, gave details of the wide range of employment in the Railway Company, methods of recruitment and qualifications for engagement, training arrangements, internal and external education (arrangements with educational authorities, encouragement for staff in further education), &c.

Principal J. Cameron Smail (Heriot Watt College, Edinburgh), said that the psychological value of the "sandwich" system was insufficiently appreciated. Colleges were confronted with difficulties in staffing and equipment, the varying degrees of sympathy and indifference of employers and the consequent variation in the attitude of students. Industries were advancing, and the shortage of well-educated young people was likely to force the matter to a definite issue in the near future.

Training Craftsmen

Dr. F. T. Chapman (Board of Education) said that the most urgent educational problem before industry in this country at present was the training of craftsmen. The training of technologists was in a much more satisfactory position, though capable of improvement in detail. For training skilled craftsmen he suggested recruitment at the age of thirteen to a junior technical school or trade school followed by an apprenticeship terminating at twenty to twenty-one, during which half or more of the first two or three years was spent in an apprentice school either within, or closely associated with, the works. Apprentices with special ability would come to the front in the apprentice school, and for them special opportunities for further education should be provided on a part-time or sandwich basis for the remainder of their apprenticeship; in special cases that would be followed by two years' full-time education which would lead to a degree. Thus, such a scheme would produce, besides a supply of good craftsmen, a stream of men well qualified to occupy managerial and technical posts.

Professor Willis Jackson, discussing "post-advanced education," dealt with a very recent development in technical education which he regarded as of the greatest importance. It had been very gratifying to note that during the past few years there had been a considerable extension of post-graduate practical training, and on the electrical side he said that practically every firm of note had now introduced a scheme of post-graduate apprenticeship and only in exceptional circumstances did they recruit graduates direct to technical or other positions. He drew attention, also, to the provision made in certain local technical institutions, acting in close co-operation with surrounding industrial concerns.

Training in workshop organisation and management and business practice could be dealt with quite satisfactorily by arranging for students to spend some part of their long vacations with industrial concerns and by ensuring that during these periods they read suitable elementary books on these subjects. These largely non-technical subjects should be taken in the early part of the period of apprenticeship.

Mr. S. E. Goodall (Metropolitan-Vickers Electrical Co., Ltd.) mentioned a form of apprenticeship developed by his company some twelve years ago, covering a period of five years' practical and theoretical experience, and said the accumulated evidence of the past seven years since the first apprentices had completed their five-year periods of training after leaving school had fully justified the experiment. Last year, of 19 apprentices who took their final degree examination, seven obtained first-class honours, six second class, five passed and one failed.

Motor Survey—V

Heavy-duty Applications

Requirements and How They are Met

There is a tendency nowadays to classify special and modified general-purpose motors according to the industries for which they are specially designed or suitable, but there are many applications common to several industries and the information in this article in particular has been selected largely for its value as guidance in the choice of motors for some of the larger applications

THE term "heavy-duty" is here used mainly in the sense of large motors and in contrast to electrical performance and heavy-duty in respect of rough usage, which aspects were covered in previous articles for all sizes of motors.

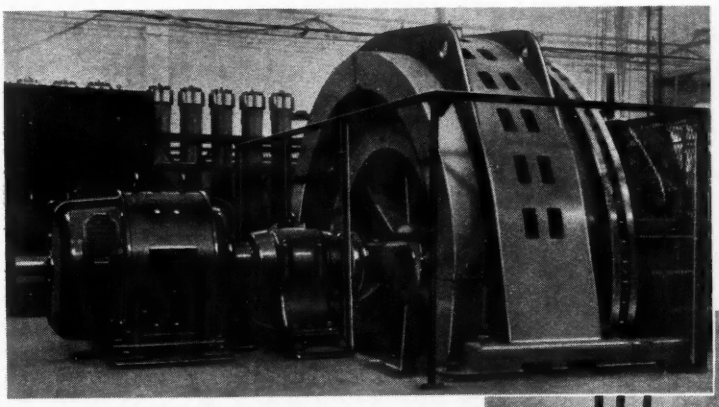
A requirement common to very many applications—shears, presses, punches and dough-mixing machines—is high slip because of the high peak load of the driven machinery Mr. Nixon (Brush Electrical), pointed out that the high motor slip allowed flywheel energy to be utilised for reducing the current consumption during the peaks. Referring to Brush high-slip motors, he said that the high-slip in the case of squirrel-cage motors was brought about by specially designed end rings to give rapid heat dissipation. For slip-ring motors external "slip resistance" was used.

A remarkable trend nowadays is the direct switching to line and, contrasting to some extent with the ideas about the risks involved in direct switching, the results of a research by Metropolitan-Vickers are particularly illuminating. It was shown, in the case of a 900-HP squirrel-cage motor on a mine pump with an auto-transformer starter, that there were mechanical forces in excess of those resulting from direct switching, and a test on a very much smaller motor showed that transient currents of between 20 and 30 times full load current might occur at the instant of change-over from the tap position to the running position of the starter.

On account of the short-circuited rotor winding the tendency of the field to collapse establishes a direct current in these windings which tends to maintain the field, allowing the starter to be opened with little or no contact arcing. When the starting handle is swung from "start" to "run" during the interval when the machine is disconnected from the line the phase position of the stator voltage may shift with respect to the supply and on reclosing the circuit the conditions are somewhat similar to those when switching an alternator on to the bus-bars without synchronising.

Experience indicates that auto-transformer starters on two-four and six-pole motors below 250 HP, on 8-pole motors up to 400 HP, and 10-pole motors up to 500 HP should give satisfactory operating results.

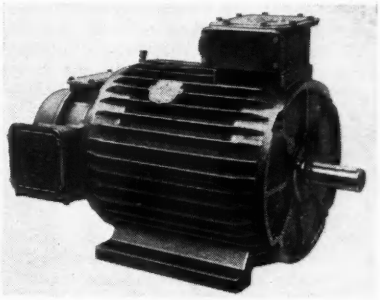
Although damage to these motors can be minimised by bracing, no amount of bracing will stand indefinitely the repeated shocks, and there is no doubt that wherever the supply undertaking will allow it direct switching has considerable recommendations from this aspect.



The uneven turning moment of the compressor creates a very bad current pulsation in the motor; an 825-HP Harland synchronous motor driving a compressor at an oxygen works

Steelworks Motors

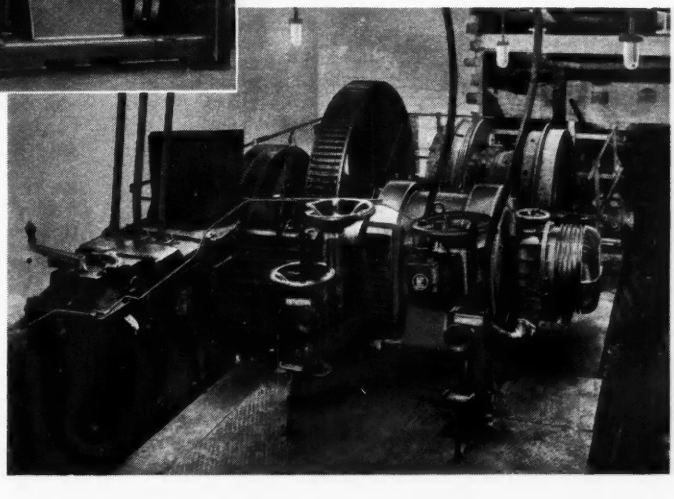
All very large motors, certainly those with HP's running into four figures, are individually made to specification and the iron and steel industry is probably the biggest user of motors of this type. A 20,000-HP G.E.C. motor which has been installed at a large steel works is an excellent example of this type of equipment. Its speed from 0 to 60 RPM is obtained by Ward Leonard control and from 60 to 150 RPM by shunt control. The motor is a double unit with two separate armatures coupled back to back by means of a large, rigid coupling unsupported by any middle bearing—an excellent space saving scheme.



Gasworks motors have to be specially designed to withstand atmospheric attack; an L.D.C. slip-ring gasworks motor

The stresses involved will be appreciated from the fact that each armature weighs 44 tons. The total weight of the motor is 260 tons. The armature stampings are secured to the hub by dovetailed keys and the complete assembly is held between two cast end-plates. The armature hub is of cast-steel and the shell is of exceptionally heavy fabricated construction. The bolts securing the pedestal of the mill-end bearing extend down through the bedplate into the foundations, so that any thrust imparted by the mill is taken by the foundations.

Mr. Hoseason (Met.-Vick.) said that the outstanding factors to be catered for in the iron and steel industry were maximum continuity of service (very robust construction); very indeterminable load (Class B insulation to permit overload); and maximum accessibility (split frames and taper shaft extensions for easy removal of couplings). The English Electric Co. referred to the excellent field of usefulness for the synchronous motor, namely, cold rolling, breaking down, finishing and tube



The English Electric Co. point to the successful application of the slip-ring motor to the three classes of mine haulages; an endless rope haulage in Scotland equipped with an 80-HP English Electric louvre-ventilated motor with flameproof slip-ring cover

draw benches where speed variation or reduction is not required. DC rolling-mill motors, said Mr. Fenemore, are compensated to enable them to take severe overloads and the scheme is successful for all sizes up to 7,000 HP continuous.

Live-race motors, according to Lancashire Dynamo and Crypto, must be capable of reversing up to 1,000 times per hour, and of standing up to unskilled handling and rough usage. Squirrel-cage motors for these drives have frames and end brackets in one piece slit at the centre line. They are made in cast-steel and cartridge bearings avoid exposing the race to the dirty atmosphere when the top half of the frame is removed. The rotor is of the "Maxtorq" type incorporating special resistance material in the end winding at one end of the motor. The resistance is separately cooled and, projecting beyond the stator winding, it has to dissipate the considerable stored energy associated with rapid reversals.

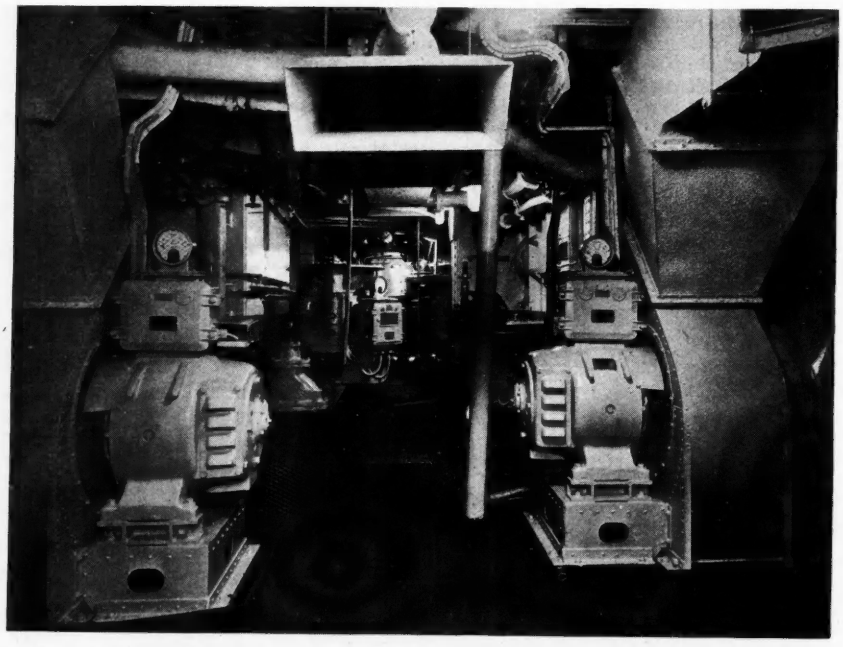
Electric Drive in Collieries

The Mines Department annual reports show that in the year 1935 about 219 million tons of coal was obtained from British collieries. Of this amount about 80 million tons was cut by electricity and 33 million tons compressed air. About 96 million tons of coal was carried by conveyors, of which 73 million tons was conveyed direct into tubs, the balance being conveyed with gate-end loaders. These figures indicate the extent to which various classes of motor are used in the collieries. We have already shown how flameproof requirements govern the majority of below-ground motors and the essential features of these motors.

The English Electric Co., drawing attention to the comprehensive use of motors in collieries nowadays, says that most of the duties can be successfully undertaken by the AC motor. The average well-mechanised mine has at least one ventilating fan, a number of pumps, air compressors for the drills, various haulages, a winding engine and some coal cutters, all served electrically.

In pointing to the relative advantages of AC and DC motors for winder driving the G.E.C. says that slip-ring motors have the advantage of low first cost and no consumption when standing, while their disadvantages are low overall power factor and losses in external resistance during acceleration and in the case of reverse current braking during deceleration.

The Ward Leonard control associated with DC motors eliminates resistance losses during acceleration and returns energy to the line during the braking period. But against this and other advantages there are greater complications, high first cost and stand-by and windage losses of the M.G. set. Features of the winder motors are: laminations built on dovetailed keys; rotor spider of steel tangentially keyed; well spaced and generous slip-rings; and ample ventilation.



Marine motors have to stand stresses caused by pitching and rolling in heavy seas; motor driven pump on a large modern liner (G.E.C.)

The English Electric Co. points to the successful application of the s.r. motor to the three classes of haulage gear, namely, main rope, main and tail rope and endless haulages. It says that the usual speeds for main haulage range between 4 and 10 MPH, the tub speed in a main and tail haulage is usually about 8 MPH and that the rope speed of the endless haulage is usually about 2 MPH.

Greenwood & Batley told us that they did not supply s.r. motors nowadays for either coal cutters or conveyors and that they regarded the coal cutter motor as rather a freak because of the necessity of keeping the height of the cutter to the minimum.

Difficulties with gasworks motors concern atmospheric attack on the materials and Lancashire Dynamo expressed the opinion that cast iron was the best metal to stand up to these conditions. Gasworks fumes have a deleterious effect on both the insulation and copper, so that the windings have special varnish seals and many coats of finishing enamel over and above the normal impregnation.

An outstanding development of the present time is the attention which is being given to boiler-house motors and the English Electric Co. said that in many instances it was imperative to use a totally enclosed fan-assisted motor because of the dust in the atmosphere. The present tendency is to use larger squirrel-cage motors with direct switching to simplify control. Certain parts of a power station are subject to high-frequency vibrations and in these cases special attention should be given to the right choice of bearing.

The Harland Engineering Co. said that the requirements of the boiler feed motor were high speed, low starting current and rapid acceleration and that it was often necessary to get feed pumps into service in 20 seconds. The company can design motors for such duties with starting currents down to 3 to 3½ times full load current.

Mr. Grime, of Mather & Platt, Ltd., pointed to the advantage that the boiler house motor usually had by way of good-class maintenance. He said that in many cases no-volt releases were omitted, so that the plant would start up again automatically after a failure as soon as the supply was restored and that overload protection, if fitted at all, was adjusted to permit this performance and to operate under heavy fault conditions only.

Mr. Barfield (Laurence, Scott) said that the modern boiler-house fan problem was to accelerate a very heavy fan wheel and to provide two speeds with direct switch-over from bottom to top. Total enclosure was necessary on account of the dust and the machine was usually required to keep running with a temporary drop in voltage due to distribution faults—the equivalent of overload conditions.

Traction Motors

Another heavy-duty application is traction of which, said Mr. Collett (G.E.C.), railways represent, strangely enough, the most straightforward aspect. The series motor employed is a very simple job and although one always thinks it will "run away" it must be remembered that it is coupled to gearing which is not liable to break.

The Southern Railway's policy is towards the enclosed motor while the Underground and the L.M.S. employ open machines and the good service obtained is remarkable in view of the atmospheric conditions in which they operate. Steel frames, bigger shafts and class B insulation are now practically standard construction.

The tramways motor is also series and ventilated and of similar construction to that of the railways, but it has to be made also to stand up to rheostatic braking. Such braking calls for greater output, but there is no definite tendency to install larger motors in consequence and one must consider this in conjunction with performance improvement as the result of using class B insulation.

For the trolley-bus special arrangements have to be made to obtain the required speed control because only one series motor is called for. But the trend now is towards a compound machine which permits the use of regeneration as well as rheostatic braking. Where rheostatic braking is required a compound machine provides a simple means of controlling the maximum amount of retardation at any speed.

With regard to marine applications, Mawdsleys said that the main requirements were accessibility, the motors being usually tucked away in corners by the bulkheads, high-grade insulation and large creepage surfaces, because of the humid and often hot and salt-laden atmospheres.

Usually only the deck motors are totally enclosed and the screws which have to be removed are of non-rusting metal. The motors have to be designed to stand extra stresses caused by pitching and rolling in rough seas and by direct hits by waves. Very heavy ribbing of the frames is a remedy. Bearings are called for which can be tilted 20 deg. in any direction without interfering with the lubrication.

Laurence, Scott say that all marine motors of any considerable size have split frames, while large inspection covers are fitted, in some cases with plate-glass windows, so that commutation can be examined. We have heard many reasons for the extensive use of DC on ships, but Laurence, Scott assured us that it was mainly because of the deeply ingrained early training of seamen.

At the English Electric Co. works we heard of propulsion motors for Diesel electric tugs on the Thames. They have no particular overloads and so are uncompensated and are called on for reversing duties.

Conditions in Cement Works

Crompton Parkinson said that the cement works provided a very profitable field for the synchronous motor. Cement dust in itself does not damage the windings, but it is very troublesome to bearings. The company advocates deluge motors for outside pumps, but ordinary protected machines for inside duties, with certain parts augmented with material in consequence of long service duty.

The B.T.H. Co. says that, excluding traction motors, excavators and kiln drives, practically the whole of cement works machines run continuously at full speed and in general the most suitable motor is the three-phase induction unit. The quality of the cement depends largely on the accuracy of the speed control of the kiln and either the DC or the AC commutator motor is specially recommended for this duty. While the disadvantage in either case is probably high first cost, compared with the s.r. motor, the latter is limited to a number of speeds which are rather subjected to variations of changes of load.

The G.E.C. has developed a totally enclosed motor with ribs and fan for cement works duty and Laurence, Scott recommend "Emcol" motors in this field. In remarking upon the arduous duty of the cement mill motor Mr. Riches (English Electric) said that after prolonged shut-downs a very heavy mass of balls in the mill corroded with cement had to be shifted—a call for exceptionally good starting.

With regard to chemical works, Mather & Platt stressed the importance of thorough attention to insulation and impregnation and said that while maintenance was usually of a good class motors had to run for long periods under trying conditions, calling for totally-enclosed or drip-proof features.

Lancashire Dynamo & Crypto has found that its gasworks motor often satisfies the conditions in cement works where occasionally Monel metal slip-rings have been found to be quite efficacious.

The heavy duties in the rubber industry were indicated by the English Electric Co. The rubber mill is like a huge domestic mangle into which plastic rubber is fed. Home Office Regulations demand that the motor must be capable of emergency electrical braking and because of its braking characteristics the synchronous induction motor is particularly suitable for this drive. The normal arrangement is a motor situated between two mills with power transmission both right and left.

Typical of the comments we heard on compressor requirements Mr. Greenwood (Harland Engineering) said that the uneven turning moment of the compressor creates a very bad current pulsation in the motor and so a heavy flywheel is fitted to reduce this to a reasonable value. For motors of, say, 200-HP upwards the compressor offers an excellent opportunity for the synchronous motor for both power factor correction and efficient operation.

Control of Metals

Ministry of Supply Orders

Copper, Lead, etc.

IN pursuance of an Order made under the Defence Regulations, the Minister of Supply has undertaken the control of supplies of copper, lead and zinc and such control will be exercised by a Department of the Ministry entitled the Non-Ferrous Metal Control.

1. The first of these Orders prohibits for the time being the purchase of copper, lead and zinc for consumption except under licence (this restriction does not apply, however, to existing contracts in writing or to contracts for the purpose of enabling contracts with the Government to be fulfilled, or to the purchase of copper, lead and zinc for the purpose of necessary repairs not requiring more than one ton of each metal).

2. Fixes maximum prices for copper, lead and zinc.

3. Calls for a return of information from persons concerned in the non-ferrous metal trade of stocks of copper, lead and zinc and certain manufactures of these metals on forms which are being sent to the persons concerned. Any inquiries should be addressed to the Non-Ferrous Metals Control, Ministry of Supply, c/o Postmaster, Rugby.

The export, of unwrought copper, unwrought lead and unwrought zinc and spelter and of non-ferrous scrap and old metal is being prohibited, except under licence from the Export Licensing Department of the Board of Trade.

Aluminium

The Minister has also undertaken the control of supplies and prices of aluminium, aluminium alloys, and aluminium scrap. Such control will be exercised by a department of the Ministry called the "Aluminium Control."

The Order:— (1) Prohibits for the time being dealings in and deliveries of aluminium and aluminium alloys, whether virgin or secondary, except in fulfilment of Government contracts or existing written contracts; (2) lays down maximum prices for aluminium, aluminium alloys and aluminium scrap; (3) prohibits the disposal of aluminium scrap, except through authorised dealers and smelters; and (4) requires returns of information in regard to aluminium and its manufactures.

The export of raw aluminium, and aluminium scrap is prohibited except under licence from the Export Licensing Department of the Board of Trade. Any person who carries on the business of a dealer in or smelter of aluminium scrap who wishes to obtain the necessary authorisation to continue in such business should communicate with the Controller of Aluminium as soon as possible. A list of authorised dealers and smelters will be issued in due course.

The provisions of the Order do not prevent a consumer of aluminium from re-melting the scrap produced in his own works *for re-use in the same undertaking.*

Attention is drawn to the fact that the conditions under which trading may be carried out are subject and without prejudice to all the powers of requisition. Such requisition, if made, would in no case be at prices exceeding those laid down in the Order.

As soon as circumstances permit a further Order will be issued under the terms of which consumers will be in a position to apply for licences to obtain aluminium to fulfil new contracts for *essential* civilian uses. When this further Order is made a further notice will be issued.

Any inquiry relative to the Control should be addressed to the Aluminium Control, Ministry of Supply, c/o Postmaster, Shrewsbury, Salop.

Iron and Steel

A further Order establishes a control of the iron and steel industry. Licences are required to acquire iron and steel goods and certain raw materials, but provision is made for exemption, by notice, from the necessity to obtain a licence in favour of certain classes of purchasers and/or certain purposes.

A notice is being issued concurrently with the Order providing for the exemption of the main classes of first priority users—namely, Government Departments, and purchasers requiring goods for Civil Defence purposes and railway, shipbuilding, and coal-mining undertakings. Goods forming the subject of existing contracts are also exempt from licensing, but may be subject to certain priorities. All purchasers of small quantities of goods (not exceeding 10 cwt.) and purchasers from stock-holding merchants for urgent requirements (during a period of 14 days from the date of the Order) are also exempt from licensing.

It is stated in the Order that no licences are required for dealing in scrap iron and steel, but a licence is required from the Export Licensing Department of the Board of Trade for the export of scrap iron and steel and for certain iron and steel goods.

Maximum basis prices are established for the principal iron and steel products. The prices scheduled are those current in the industry and it is contemplated that they will remain unchanged until October 31st next.

Further information may be obtained on application in writing to the Iron and Steel Control, Ministry of Supply, Steel House, Tothill Street, London, S.W.1.

PERSONAL AND SOCIAL

Information regarding new appointments and other matters of interest for this page are welcomed

THE steps which have been taken by electrical concerns during the past few days to safeguard property and employees in the event of air raids have necessitated a good deal of voluntary labour for such tasks as filling sand bags. **Mr. Leslie C. Sharp,** a director of Venner Time Switches, Ltd., has taken his share of these labours as our picture shows.

Mr. L. C. Sharp (on the extreme right) finds sandbag-filling an energetic pastime

Mr. S. E. Bold has been appointed sales engineer for the electric cooking and heating department of Carron Company. He will be responsible for the north-eastern counties, including Cumberland, Lancashire, Cheshire and North Wales, and takes up his duties immediately.

Mr. C. E. Sexton has been appointed a director of the St. Austell and District Electric Lighting and Power Co., Ltd.

I.M.E.A. Appointments.—The following gentlemen have been appointed chairmen and vice-chairmen of committees of the I.M.E.A. Council for 1939-40:—Law and Parliamentary Committee: Mr. H. C. Lamb (chairman); Mr. J. W. J. Townley (vice-chairman). General Purposes Committee: Ald. Sir Percival Bower (chairman); Mr. F. Newey (vice-chairman). Finance Committee: Ald. E. Kennedy (chairman); Ald. J. R. Potts (vice-chairman). Convention Selection Committee: Mr. J. Mould (chairman); Mr. B. Handley (vice-chairman). Electrical Apparatus Committee: Mr. G. H. Lake (chairman); Mr. W. P. Lilwall (vice-chairman). Generation Committee: Mr. W. N. C. Clinch (chairman); Mr. W. A. Royle (vice-chairman). Bulk Supply Committee: Mr. B. Handley (chairman); Mr. R. Birt (vice-chairman).

Sir Andrew Duncan, C.B.E., a member and formerly chairman of the Central Electricity Board, has been appointed Controller of Iron and Steel; **Capt. O. Lyttleton,** D.S.O., M.C., is Controller of Non-ferrous Metals (lead, copper, zinc and tin); and the **Hon. G. Cunliffe,** Controller of Aluminium. Orders dealing with the control of these materials are reported on page 333.

Mr. C. R. Spouge, of Lincoln, is the president of the National Association of Radio Retailers for 1939-40.

Mr. B. R. Bolwell, a control engineer at the Peterborough Corporation power station, was married recently at Ramsey (Hunts) Parish Church to Miss Kitty Elizabeth Freeman.

Mr. C. H. Mitchell has been appointed manager of works for the Canadian Westinghouse Co. He has been with the Westinghouse organisation for nearly forty years, and has served in England and the United States, as also has **Mr. J. T. Tiplady,** who has been appointed to the position of general superintendent.

The Institute of Electrical Communication Engineers of Japan has presented the Koseki Shohai (Distinguished Service Medal) to **Dr. Shigeyoshi Matsumae** in recognition of his important work in the field of electrical communications for many years. He has been closely concerned with the development of the non-loaded cable system of carrier communication.

Mr. F. C. Yapp, director of Vickers, Ltd., and Vickers-Armstrongs, Ltd., has been appointed deputy chairman of the latter company.

OBITUARY

Mr. J. R. P. Lunn.—We regret to report the death at Darlington, on September 5th, of Mr. J. R. P. Lunn, who retired two years ago from the position of borough electrical engineer of Darlington.

Mr. H. Bamford.—We regret to learn of the death at his home on August 30th of Mr. Harry Bamford, works manager of George Ellison, Ltd., after an illness of only one day. Mr. Bamford, who was fifty-four years of age, had been connected with the company since 1911 and had been works manager for more than fifteen years. He was chairman of the Ellison Athletic and Recreation Club from 1926.

Mr. Thomas Chalder, of Newcastle-on-Tyne, traffic superintendent for thirty-two years to the Newcastle City Council, has died, aged seventy-four. Mr. Chalder, who was formerly with Sir W. G. Armstrong Whitworth & Co., Ltd., joined the Corporation after the tramlines were laid as assistant traffic superintendent. He was later traffic superintendent and retired in 1932 on reaching the age limit.

Mr. Thomas Smith, of Monkseaton, general sales manager for C. A. Parsons & Co., Ltd., has died suddenly at the age of fifty-three. Mr. Smith had been with Parsons for nearly forty years. He leaves a widow and a daughter.

Mr. W. Saville.—The death occurred recently in British Columbia at the age of sixty-five of Mr. W. Saville, general secretary of the British Columbia Electric Railway Co. Mr. Saville was born in England and went to Vancouver in 1911, joining the company's accounting department. He became general secretary in 1918.

Mr. H. G. Riddle.—The death occurred on August 26th of Mr. Herbert G. Riddle, secretary of the Junior Institution of Engineers (Inc.). Mr. Riddle was about to retire after having completed twenty-one years' service.

Rumanian Electrical Imports

THE accompanying statement showing the imports of electrical goods into Rumania last year is based on the foreign trade returns recently issued in Bucharest. A note of increases or decreases on 1937 is added for purposes of comparison. Although Germany took by far the largest share it is noteworthy that a number of other European countries and the United States, were represented in the trade. The lei in 1938 varied between 650 and 690 to the £.

	1938 Lei (000)	Inc. or dec. on 1937 Lei (000)
Dynamos, motors, convertors, transformers, fans, etc.—		
Total	202,996	+ 52,091
From Germany	135,344	+ 56,949
,, Switzerland	18,236	+ 5,549
,, Hungary	10,350	− 3,761
,, Belgium	9,177	+ 8,837
Turbo-generators, dynamo-motor sets, and mercury rectifiers—		
Total	35,237	+ 2,471
From Germany	27,667	+ 20,659
Electrical measuring and accessory instruments—		
Total	41,767	+ 6,681
From Germany	31,056	+ 14,163
,, Switzerland	3,523	− 1,604
Distribution equipment, medical apparatus, etc., n.e.s., with windings—		
Total	117,548	+ 21,063
From Germany	79,697	+ 23,697
,, France	11,170	+ 8,562
Distribution equipment, medical apparatus, etc., n.e.s., without windings—		
Total	96,684	+ 48,091
From Germany	63,879	+ 28,167
,, France	22,012	+ 21,558
Domestic electrical appliances—		
Total	18,541	+ 961
From Germany	10,266	+ 1,116
,, United States	5,825	− 1,925
Telephone, telegraph, signalling and bell apparatus—		
Total	166,170	+ 4,014
From Germany	41,950	+ 17,138
,, Belgium	86,947	− 6,806
,, United Kingdom	23,183	+ 16,378
Radio and electro-magnetic apparatus—		
Total	199,215	− 90,577
From Germany	103,849	+ 23,045
,, United Kingdom	21,255	− 26,961
,, Holland	33,505	+ 7,864
Wire and cable, rubber insulated—		
Total	23,543	− 12,672
From Germany	19,152	− 9,306
Wire and cable, enamelled—		
Total	10,705	− 12,796
From Germany	3,587	− 3,264
From Belgium	5,452	+ 3,130
Wire and cable, with silk—		
Total	1,017	− 1,170
From Germany	674	− 675
Wire and cable, metal armoured—		
Total	136,387	+ 25,800
From Germany	64,580	− 21,893
,, United Kingdom	58,258	+ 42,322
Insulating tubes—		
Total (mainly from Germany)	6,142	− 240
Electric lamps—		
Total	28,633	− 20,544
From Germany	6,017	+ 3,227
,, Hungary	20,032	− 5,930
Radio valves—		
Total	32,065	− 16,873
From Germany	13,439	+ 4,077
,, Holland	1,767	− 2,243
,, Hungary	9,855	− 344
Carbons and electrodes—		
Total	15,278	+ 2,579
From Germany	13,027	+ 2,998

COMMERCIAL and INDUSTRIAL NEWS

Centralised Control at Blackpool. Removals. B.E.A.M.A.'s Decision. Bright Annealing Furnace. Bulgarian Electrical Imports. Engineering Labour Agreement

Radio Retailers

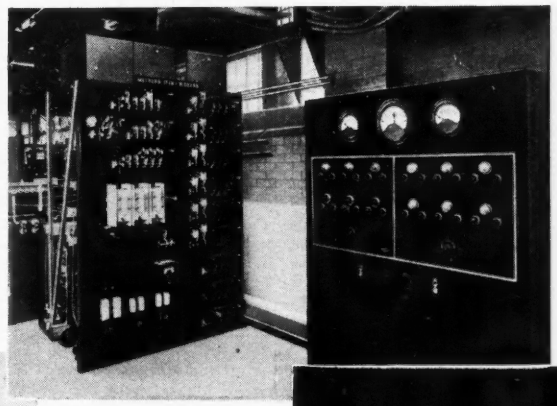
THE September issue of the official organ of the Electrical Contractors' Association contains a summary of the report and address of Mr. F. J. Smith, 1938-39 president of the National Association of Radio Retailers. During the past year a branch was established at Blackpool, and local associations in Southampton and West Herts joined the Association as complete units. Contacts were established with the Scottish Radio Retailers' Association.

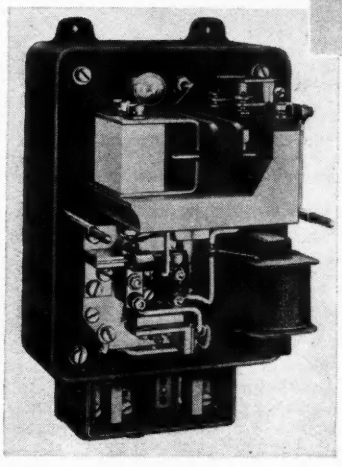
Publicity activities have included a leaflet addressed to the public and a stand at Radiolympia. The Association had been invited to nominate members to various committees of the British Standards Institution and it is also co-operating with the Retail Distributive Trades Conference which deals with wages and conditions. Other activities have included the re-issue of the list of used set allowances, a list of registered radio retailers and the securing of a revision of the agreement drawn up by the Association of Radio Battery Makers. A proposal is being discussed that a charge of 5s. shall be made for carrying out various tests, cleaning, &c., and to cover the cost of estimating. An arrangement has been made with the Institution of Public Address Engineers for the N.A.R.R. to carry out all secretarial and organisation work for the I.P.A.E.

Centralised Control System at Blackpool

The "Ripplay" equipment developed by the METROPOLITAN-VICKERS ELECTRICAL CO., LTD., for centralised control of A.R.P. signals, &c., has been installed for Blackpool Corporation to the requirements of Mr. H. F. Shanahan, borough electrical engineer. For load control, any unit of load on the network can be switched on or off from the power station. For signal communication, simple receiving devices may be connected at various points on the system to pick up appropriate signals.

The "Ripplay" system superimposes on the normal 50-cycle power supply frequencies ranging from 400 to 1,000 oscillations per second, definite frequencies being used for different switching or signal purposes. By means of a dial on a control board at a central point the required ripple frequency may be selected and by pressing a push-button the impulse is transmitted throughout the distribution system. The method involves no change in the existing high-voltage bus-bar or distribution equipment, and is applicable to any kind of network. Power consumption is said to be negligible.





Left: Internal view of the "Ripplay" control. Above: Control panel and contactor board. Right: Side view showing chokes and condensers

United States Electrical Orders

Bookings of orders for electrical goods in the United States during the second quarter of 1939 continued the upward trend of the past year and were 30.6 per cent. over the second quarter a year ago, according to the Bureau of the Census. The *Electrical World* states that seventy-eight manufacturers of electrical goods report that the value of new orders booked amounted to $205,567,343, as against $197,654,216 in the preceding quarter, $154,153,559 in the first quarter of 1938 and $157,315,411 in the second quarter. The total for the half-year, $403,221,559, shows an increase of 29.5 per cent. over the corresponding figure last year. It was the largest first half-year figure since 1930 with the exception of 1937. In that year orders for the first half rose to $531,900,162. The bookings include electric motors, storage batteries, domestic appliances, industrial equipment and other electrical apparatus and supplies.

Electric Cuckoo Clock

In one of the main streets of Liverpool there is what is claimed to be the only public electric cuckoo clock in the country. It is fixed outside the premises of Messrs. Schierwater & Lloyd, Church Street. The call of the cuckoo is heard each hour. At the base of the clock there is a housing for the two cuckoos—one at each side—which make their appearance when the doors of the housing open each hour. Loud speakers are concealed in the clock, and through these are reproduced the sounds of the cuckoos—the number of cries varies from one to twelve, according to the hour—which are transmitted from the shop below. In the shop is the amplifier connected to a microphone which is placed in front of the bellows, the latter producing the sound of birds. The clock itself is operated from a battery and is worked from a master clock in the shop. The doors of the housing and cuckoo bellows are electrically operated. This novel clock was manufactured by David Rowan (Vidro), Ltd., Liverpool 20, whose principal business is that of neon sign manufacturers.

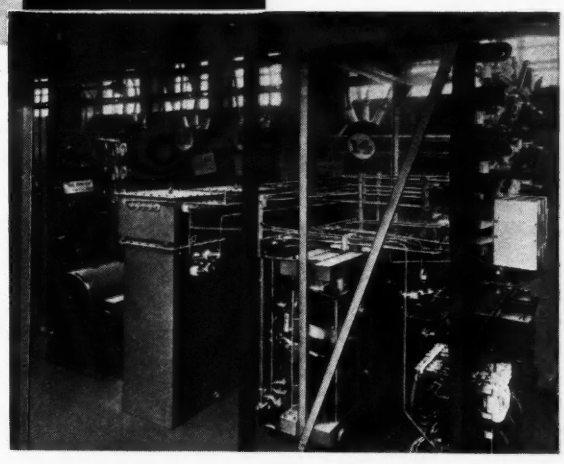
Temporary Removals

Until further notice, the business of the Electric Vehicle Association will be carried on from the private address of Mr. J. Steele, "Little Bowling," Upway, Chalfont St. Peter, Bucks (telephone: Gerrards Cross 2291.)

The offices of the Public Service Transport Association have been transferred to Windyridge, Epsom Lane, Epsom, Surrey.

S. Guiterman & Co., Ltd., have removed to 1-2a, High Street, Redhill, Surrey (telephone: Redhill 3345).

The new address of the Oriental Telephone & Electric Co., Ltd., is 11, Money Hill Parade, Uxbridge Road, Rickmansworth, Herts (telephone: Rickmansworth 3284)



The Woodall-Duckham Vertical Retort & Oven Construction Co. (1920), Ltd., is now at Uplands, Epsom Road, Guildford (telephone: Guildford 3267).

Communications to the Association of Supervising Electrical Engineers should be addressed to 36, Heddon Court Avenue, Cockfosters, Barnet, Herts (telephone: Barnet 5660).

Marconi-Ekco Instruments, Ltd., are now at Knoll Cottage, Gills Hill, Radlett, Herts (telephone: Radlett 6521).

The emergency headquarters of Bakelite, Ltd., are at Brackley Lodge, Brackley, Northants (telephone: Brackley 144).

Kennedy & Donkin have opened an office at Holme Chase, St. George's Avenue, Weybridge, Surrey (telephone: Weybridge 3648).

W. T. Henley's Telegraph Works Co., Ltd., have removed their head office from Holborn Viaduct to Milton Court, Westcott, Dorking, Surrey (telephone: Dorking 3241; telegrams:

Henletel, Dorking. All communications normally addressed to the branches, or to the works at Woolwich or Gravesend should continue to be sent direct to them.

Mr. D. Sinclair has removed his business address to 5A, Station Parade, Denham, Bucks.

The bulk of the business of Ernest B. Westman, Ltd., is being conducted from "Torpa," Crooks Hill Road, Meadvale, Redhill, Surrey.

The Engineer's Department of the Gaumont-British Corporation, Ltd., is now at The Gaumont, Bishopsford Road, Morden, Surrey (telephone: Mitcham 2414).

Carrying On

The British Electrical and Allied Manufacturers' Association informs us of its intention to carry on its work in London until it is considered that the organisation could better serve the industry and Government by moving to another centre. As the only organisation which provides a means of obtaining the collective view of the electrical manufacturing industry, it is of considerable importance as was proved during the last war, when it was able to give the country valuable service. B.E.A.M.A. is maintaining close contact with the Central Electricity Board, the Electricity Commissioners, and all Government Departments interested in the supply of electrical machinery.

A similar communication has been received from the British Engineers' Association, which states that unless it is compelled to leave London it will continue to operate at its present headquarters.

Japanese Electric Lamp Exports

The Japanese Electric Lamp Exporters' Association states that the exports of electric lamps for June this year (excluding those to Britain) totalled 12,510,000, valued at 522,000 yen, showing a decrease of three million lamps, though the value increased by 92,500 yen compared with the corresponding month of last year. The aggregate total exports of electric lamps for the first six months of this year were 53,330,000, valued at 2,548,000 yen. Compared with the corresponding period of 1938 there was a decrease of 1,544,000 in number but an increase in value of 668,000 yen. Shipments to the United States have increased considerably recently.

Bright Annealing Plant

At a new mill at the works of Arthur Lee & Sons, Ltd., electric furnaces have been installed comprising a large continuous-roller hearth unit and four 88-kW vertical cylindrical units of the Grunewald batch type, all supplied by the General Electric Co., Ltd., and manufactured at the company's Fraser & Chalmers Engineering Works.

The roller hearth furnace is for the continuous bright annealing of cold-rolled strip and also for the normalising and descaling of hot-rolled strip in lengths. It is suitable for operation up to 1,000 deg. C., and the normal output is 15 cwt. per hr.

The internal width is 2 ft. and the overall length 114 ft., which includes charging and discharging tables, heating chamber, entrance and exit vestibules, and cooling chambers. An atmosphere of hydrogen and nitrogen is obtained from cracked and burnt ammonia produced by an I.C.I. regenerative plant.

The heating elements of nickel-chrome strip wound in sinuous form, are arranged in the roof and in the hearth of the insulated heating chamber zones, connected to a low-voltage supply from 6.6-kW three-phase transformers.

Each heating zone is provided with independent automatic temperature control gear, comprising three Cambridge direct deflectional regulators together with push-button switches, red and green pilot lamps and time switch, all mounted on the front of a floor cubicle. The temperature control instruments can be preset to suit particular requirements.

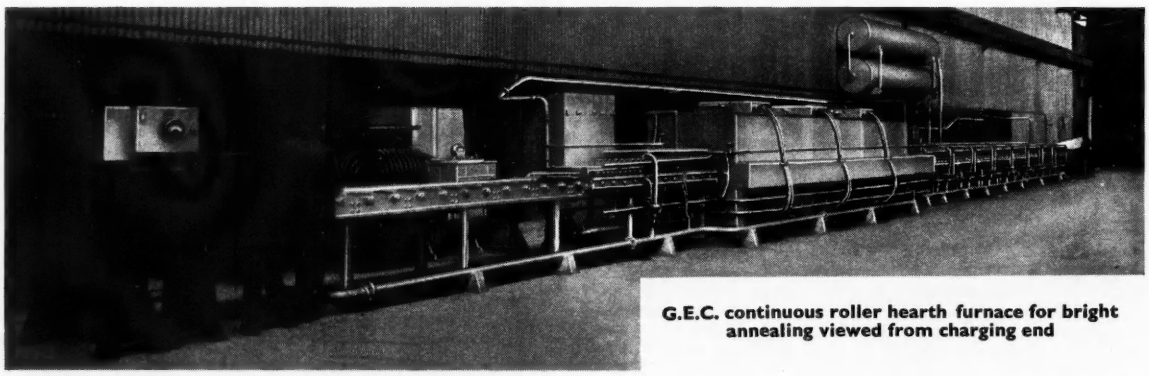
A roller hearth is provided throughout the length of the furnace with a speed range of 12 to 1, thus enabling the same output to be obtained with different thicknesses of strip. Each section of the roller hearth is connected by a fixed reduction gear unit to a main line shaft running underneath the furnace. The line shaft is driven by a 7½-HP G.E.C. squirrel-cage motor through variable-speed reduction gearing. The rollers, where subjected to heat, are of special nickel-chrome alloy; elsewhere they are of mild steel. The cooling sections are divided into units, each having a separate water supply.

The four vertical furnaces are equipped with automatic temperature control and Grunewald bright annealing pots.

One of these was the first of its kind in Great Britain for the bright annealing of steel. The charge is suspended from the underside of the pot cover and not from the pot envelope, which is of thin heat-resisting low thermal-capacity alloy. Each pot is sealed by a rubber ring cooled from the outside by a trickle of water.

The automatic temperature control gear comprises a Cambridge direct deflectional controller working from a thermocouple situated on the furnace, together with pilot lamps and switch and fuses for the control circuit. A mercury switch makes and breaks the contactor coil circuit. A time switch switches the furnace on or off automatically at any predetermined time. An additional Cambridge indicating pyrometer on the control panel is worked from a thermocouple in the middle of the charge in the pot.

The switchgear consists of a pedestal-mounting oil switch and an air-break contactor, which cuts in and out a portion of the load just before the set temperature is reached, thus avoiding over-shooting. Each pot takes a charge of approximately 30 cwt., the time of treatment being six hours as against the 24 hours required with the standard method.



G.E.C. continuous roller hearth furnace for bright annealing viewed from charging end

Trade Announcements

The Rotary Engineering Co. 27, Douglas Street, Glasgow, has been appointed the sole Scottish agent for Durham Cables, Ltd., and also for T. Price & Son (Stampers), Ltd., for "Sterling" domestic electrical appliances and "Prelect" irons. Large stocks are carried.

H. M. Walters & Co. have opened a London office at 120, Victoria Street, S.W.1 (telephone: Victoria 5273). The head offices will remain at Diceland Works, Banstead, Surrey.

Arc Lamps and Blue Prints

An illustrated booklet of 31 pages on "Enclosed Arc Lamps," dealing with their underlying principles, operation troubles and remedies, has been produced by Charles H. Champion & Co., Ltd., and can be obtained free of cost by plan printing operators and draughtsmen. Much attention is given to the avoidance of air leakage with a view to maintaining the quality of the light emitted at the widest end of the spectrum, by carbons burning in a reduced atmosphere composed chiefly of N_2, CO and CO_2, since the emulsion characteristics of printing papers are generally most sensitive to light of this kind, in which shorter exposures suffice.

New Fires

Berry's Electric, Ltd., draw our attention to the fact that one of their fires illustrated on page 261 of the August 25th issue of the ELECTRICAL REVIEW is not the "Justaberry" but the "Perrysette No. 612P."

Trolley Buses for Hastings

The Associated Equipment Co., Ltd., has received an order from the Hastings Tramways Co. for twenty 661T type double-deck trolley-buses of A.E.C.-English Electric design.

Bulgarian Electrical Imports

In his report on the economic and commercial conditions in Bulgaria (Stationery Office, 1s. 6d. net) Mr. T. V. Brenan, Commercial Secretary to H.M. Legation at Sofia, gives a list of imports into Bulgaria during 1937 and 1938. This shows that imports of electric lamps increased from 26 to 41 metric tons in weight, and from 9,208,000 to 14,521,000 leva in value. Copper wiring and cable imports rose from 596 to 883 metric tons and from 21,537,000 to 33,601,000 leva. There was a fall in the imports of radio instruments and parts from 264 to 172 metric tons, with a decrease in value from 73,453,000 leva to 42,437,000 leva. Motors and turbines and parts increased from 254 to 356 metric tons, and from 11,239,000 to 20,916,000 leva, electrical appliances and parts from 455 to 797 metric tons (24,678,000 to 39,691,000 leva), and electric motors, &c., and parts from 343 to 525 metric tons and from 24,678,000 to 39,691,000 leva.

Radio and Television Courses

Courses in radio and radio-gramophone service work and radio and television engineering commence on September 25th at the Polytechnic, Regent Street, London, W.1. These courses extend over a period of five years and provide for a thorough training in the principles and technique of the subjects. The first three years of the courses are approved for the award of the "ordinary" national certificate granted by the I.E.E. in conjunction with the Board of Education. Prospectuses can be obtained on application to the Electrical Engineering Department of the Polytechnic.

Trolley-bus Order from South Africa

A further repeat order for Sunbeam-B.T.H. trolley-bus chassis has just been received by Sunbeam Commercial Vehicles, Ltd., from the City of Johannesburg. This order is for twenty-five chassis of the MF.2 four-wheel type, similar to those previously supplied to Johannesburg in 1936 and 1938 respectively. The bodies for these new vehicles will be built by Metropolitan Cammell Weymann, Ltd.

Engineering Labour Agreement

An agreement was reached last week between the Engineering and Allied Employers' National Federation and the Amalgamated Engineering Union on the increase of the labour force in the engineering industry. It was stated that the rapid expansion of armament production had put a strain on the industry, and the addition of large new factories might further develop a situation where the fullest production would be prejudiced. In order to provide for this and to supplement the skilled manpower where it could be shown that skilled men were not available and production was prejudiced it was agreed that an alternative class of worker might be employed on jobs hitherto done by skilled members of the union under reservations mutually accepted. There was an undertaking that the normal practice should be restored when the emergency had passed The Agreement applied to "Peace time emergency conditions," and it was recognised that greater demands would be made on the labour power of the industry in war time.

Readers are earnestly requested to instruct their local newsagents to reserve a copy of the ELECTRICAL REVIEW for them regularly in order to facilitate distribution arrangements and avoid the risk of failure to obtain copies.

In the interests of the paper itself in these difficult times it is particularly hoped that regular purchase will be made from the same newsagent or bookstall each week.

Cancelled Events

The Institution of Electrical Engineers officially announces that the week-end visit which members of the Transmission Section were to have paid to Yorkshire on September 16th and 17th has been cancelled.

The Engineering and Marine Exhibition which was to be held at Olympia from September 14th to 30th has been postponed indefinitely.

The Motor Show and the Commercial Motor Exhibition have been cancelled.

New Catalogues and Lists

Premier Electric Heaters, Ltd., Keeley Street, Birmingham, 9.—A comprehensive coloured folder on electric fires.

Cooper & Smith, 94 Charlotte Street, London, W.1.—Folders on roll-top signs and the "Rigalite" table standard.

British Insulated Cables, Ltd., Prescot.—A list of rubber cables and wires.

Constructors, Ltd., Tyburn Road, Erdington Birmingham.—Details of "Consul" portable air-raid shelters.

James Gordon & Co., Ltd., Dalston Gardens, Stanmore, Middlesex.—Pamphlet No. H27 dealing with Hagan automatic boiler control.

British National Electrics, Ltd., Newarthill, Motherwell, Lanarkshire.—A new fire broadsheet and general catalogue.

J. A. Brook, Ltd., Lord Street, Huddersfield.—The 1939-40 list of the company's lamp locks.

Spencer Wire Co., Ltd., 11, Queen Victoria Street, London, E.C.4.—A list of copper extras and a collection of technical data.

Revo Electric Co., Ltd., Tipton, Staffs.—A 28-page illustrated brochure of electric fires.

A.R.P. Lighting Equipment

THE following notes regarding the apparatus available for A.R.P. domestic lighting may be of use to readers. The list does not pretend to be complete, but is fairly comprehensive.

With the windows completely blacked out no attention is necessary to the existing lighting installation, except perhaps to have a low-wattage or blue lamp or other well-shielded light available for use temporarily when fixing up the black-out arrangement in the dark. It is, of course, better not to wait until it is quite dark before blacking-out, in case someone unwittingly switches on the lights.

The blue lamps referred to are made by the leading lamp manufacturers, generally in 40-W sizes, and give just sufficient light to enable objects in the room to be distinguished. With an ordinary semi-transparent curtain no light is visible from outside so that they would appear quite suitable for bedrooms, &c., where the minimum of light is adequate. They can often be used too for halls and landings, provided in the former case that the light is not too close to the front door and that the door is not opened too wide. Even if a blue lamp is used landing windows should still be darkened.

There are, of course, numerous instances in which it is not practicable or desirable to utilise black-out devices. In such cases it may be possible to employ lamp shields such as are made by the Nox Electric Lamp Co., Ltd., Clarence Road Works, Hunslet, Leeds, or special reflectors, such as Best & Lloyd, Ltd., 40, Great Marlborough Street, London, W.1., have just brought out. Special dark shades for table lamps, &c., are made by, among others, Waite & Son, Ltd., Menin Works, Bond Road, Mitcham, while Harcourts, Ltd., Stanhope House, 1, Kean Street, Aldwych, W.C.2., are selling a special A.R.P. wall-bracket called the "Flexo," which is adjustable and directs the light only where required. Many other adjustable fittings are suitable, such as those produced by the Typerlite Co., 86, Cannon Street, E.C.4.; Mek-Elek Engineering, Ltd., 16, Douglas Street, S.W.1.; H. Terry & Son, Ltd. ("Anglepoise"), Redditch; John Dugdill & Co., Ltd., Hazel Grove, Stockport; the Electric Depôt, Ltd., Aston Birmingham; and Drake & Gorham Wholesale, Ltd., 77, Long Acre, W.C.2.

In addition to the "Moonbeam" bedlamp, which clamps on to the back of the bed and, incorporating a magnifying lens, gives a powerful concentrated beam over a very small area, L. G. Hawkins & Co., Ltd., 30-35, Drury Lane, W.C.2, have recently introduced the dry battery operated "999 Supreme" emergency lantern which can be stood up, hung from the arm or suspended in an air raid shelter. Oldham & Son, Ltd., Denton, near Manchester, have also brought out a new emergency lantern the "Toucan," in which an entirely new type of accumulator is employed and which is extremely robust in spite of its light weight. We hope from time to time to give details of other special equipment produced by manufacturers to meet the present situation.

Fuel Rationing

ON Monday last the Mines Department made four Orders under the defence regulations governing the sale and consumption of coal, electricity and gas.

The first of these stipulates that no coal can be sold for export except at a permitted price. The second limits inland wholesale prices to an amount which will give the distributor a margin not greater than it was on comparable sales made during the previous year. This Order took immediate effect.

The third Order which comes into operation as from September 16th provides for the fixing of retail prices. Assurances have been given by the leading coal and coke producers that no increase in price will be permitted except after consultation with the Mines Department, while the principal coal and coke merchants' organisations have undertaken not to increase prices for a fortnight.

The Fuel and Lighting Order which is to be put into force as from September 7th is designed to conserve supplies and provide against local shortages. It provides that the quarterly consumption of coal, electricity and gas by domestic and small industrial consumers shall be limited to 75 per cent. of the quantities consumed in the corresponding quarter of the year ended June 30th last. The percentage may be varied by the Secretary for Mines. The administration of the Order will be in the hands of local fuel overseers and local advisory committees of supplying interests.

As regards coal there will be a minimum allowance of two tons per annum. Consumers requiring more than this will obtain a certificate from the local overseer which must be produced when they purchase coal.

The corresponding minimum for electricity will be 200 kWh per annum. There are, however, two special provisions:—(1) Prepayment consumers taking supplies at the lighting flat rate will not be rationed. (2) Consumers with no other means of cooking than by electricity can apply to be allowed a minimum of 1,000 kWh per annum.

The minimum allowance of gas is fixed at 100 therms.

ELECTRICITY SUPPLY

Influence of Domestic Supplies at Stoke-on-Trent. Swedish Hydro-electric Development. Power Production in Switzerland

Barrow-in-Furness.—ELECTRIC WATER HEATING ADVANCE.—A considerable increase in the water heating load, chiefly due to the installation of electric circulators, is recorded in the 1938-39 report of Mr. J. E. Shepherd, borough electrical engineer. He also draws attention to the progress which electricity is making for such agricultural purposes as sterilisers, steam raisers, &c. A radiant heating installation has been provided at a new nursery school and the result is awaited with interest "as it may revolutionise the system of heating in schools." With regard to development generally, the demand continues to increase both in Barrow and the rural area, and the Electricity Department has been kept particularly busy during the year. Demonstrations and lectures have been well attended. Total sales during the year increased from 35.2 million to 35.9 million kWh, or nearly 2 per cent., the smallness of the rise being due to a reduction of 1.7 million kWh in power and industrial supplies. Domestic consumption on the other hand improved by 16 per cent. to over 14 million kWh. The number of consumers rose by 1,775 to 19,980 and the connected load by 9,760 kW to 70,602 kW. For the previous four years the undertaking's load factor was over 43 per cent., but with a rise in the maximum load from 11,535 kW to 13,020 kW the load factor deteriorated to 38.51 per cent. The total revenue for the past year was £163,384 (against £151,786 in 1937-38) and the working expenditure £100,817 (£90,526), leaving a gross profit of £62,567 (£61,260). After payment of all charges there was a surplus of £5,976 (£15,837).

Belgium.—JOINT SUPPLY TO 56 COMMUNES.—The local authorities of fifty-six small communes in the Brussels area have recently joined together in forming a company to be known as the Société Intercommunale d'Electricité de l'Est et du Centre du Hainaut to take over the electric power supply in their districts at present carried out by the Société de Gaz et d'Electricité du Hainaut.

Exeter.—WIRING INSTALLATIONS.—The Electricity Committee is applying for permission to borrow £2,500 for wiring installations.

Glasgow.—NEW LIGHTING CONTROL STATION.—The new Langside lighting control station recently erected by the Corporation was formally opened on September 1st, by Bailie R. Y. Gemmell, convener of the Fire Brigade and Lighting Subcommittee. The new station forms part of the scheme for rearrangement of the present 14 divisions of the city for lighting, extinguishing, and maintaining the street and stair lamps, and a feature of the building is a control board which lights and extinguishes several thousand lamps in districts including Pollokshields, Queen's Park, King's Park, Croftfoot, Newlands, Pollokshaws and Nitshill.

ELECTRICITY IN SCHOOLS.—The Education Committee has authorised the director of education to arrange with the Electricity Department for electrical work to be carried out at the Keppoch and King's Park temporary schools.

Liverpool.—DEVELOPMENT.—In its area of 142 sq. miles the Electricity Department sold 511.2 million kWh during 1938-39 at an average price of 0.97d.; this was the first time that the price had fallen below a penny. Compared with the previous year sales showed an increase of 37.9 million kWh, or 8 per cent. To cope with industrial, domestic and rural development considerable additions to the distribution system have been necessary. At the end of March last there were 33,785 cookers, 6,330 water heaters, 6,177 wash boilers and 3,763 radiators on hire.

The total income during the year was 2,243,714. The gross profit, after payment of income tax, was £974,536 (compared with £918,638 in the previous year) of which £761,298 (£694,319) was required for interest and sinking fund payments and £112,405 (£22,136) for development expenditure out of revenue. For the seventh year £70,000 was contributed in aid of the rates, while £30,833 (£132,183) was allocated to reserve and renewals.

Stoke-on-Trent.—LOAD TRENDS.—The report of Mr. C. H. Yeaman, city electrical engineer, is a most interesting document, in which the progress of the undertaking since its inception is surveyed and many aspects of the service illustrated by photographs.

A point emphasised is the effect of domestic development. The load curves of a sub-station on a Corporation housing estate during the first week in May last show that the maximum load on Sundays was more than twice the weekday peak, due to the use of electric cookers. The sub-station engineer used to leave the overhaul of plant till Sunday, says Mr. Yeaman; nowadays such work is restricted to a few hours after midnight, and with the growth of thermostatically controlled water heating soon these few hours will cease to be in the "valley."

During the past year sales under the multi-part and all-in tariffs increased by 4.9 million kWh (43 per cent.) to 16.1 million kWh; for the first time the rise in sales under these tariffs exceeded the increase in power supplies. On the industrial side the results were affected by a falling off in trade, and there was an increase of only 1.2 million kWh (2 per cent.) in sales compared with 10.2 million kWh (16 per cent.) in the previous year. The electrification of the pottery industry continued, and some headway was made in the coal industry. Four electric kilns were connected during the year and one was temporarily disconnected, so that the total number in commercial use at March 31st last was 24. Of these 23 were enamel decorating kilns and one a glost kiln which requires much higher temperatures. It is hoped that during the present year another glost kiln will be brought into use at the new Wedgwood factory at Barlaston.

Altogether the Department sold 120.7 million kWh, an increase of 9.1 million kWh, or 8 per cent. Revenue rose by £36,463 to £476,589, while expenditure increased by £77,489 to £476,460, more than half of the rise being accounted for by bulk supply cost. There was a net profit on the year's working of £5,308 compared with £45,324 in the previous year With £3,300 from interest, &c., this increased the reserve fund by £8,608, but after deducting £30,101 for expenditure on meters, &c., there was a net reduction in the reserve fund of £21,493.

Sweden.—WATER POWER FORECAST.—It is reported that at the end of 1938 the capacity of hydro-electric plants was 1,700,000 kW and on the basis of the construction programmes so far made public it is estimated that in 1945 the total exploited hydro-electric power will have risen to 2,200,000 kW.

Switzerland.—ELECTRIC POWER PRODUCTION.—According to the *Bulletin* of the Swiss Association of Electrical Engineers, the total output of electric power in Switzerland by plants of a capacity exceeding 300 kW amounted during the twelve months ending with September, 1938, to 7,054 million kWh, as compared with 6,855 million kWh in the preceding year, an increase of about 2.9 per cent. Included in the figures were 11 million kWh and 13 million kWh of "imported" power in the respective two years. Of the total 1,648 million kWh was generated at stations supplying the Federal Railways.

Workington.—LOAN FOR SWITCHGEAR.—Application is being made by the Electricity Committee for permission to borrow £4,700 for switchgear, &c.

Worsley.—HOUSE INSTALLATIONS.—The Urban District Council proposes to have electricity installed in houses on the Peel Lane site.

TRACTION

Brighton.—THE LAST TRAM.—The trams at Brighton have now been completely withdrawn, the services being taken over in most cases by trolley-buses. The final tram ran on Friday of last week from the Aquarium to the Lewes Road Depôt.

Holland.—RAILWAY ELECTRIFICATION.—In a recent issue of the *Revue Générale d'Electricite* M. R. d'Aboville deals at length with the progress of railway electrification in Holland. Tables included in the article show that fourteen sections of the system of the Dutch State Railway Exploitation Co., with a total length of about 312 miles, are now electrified, representing about 15 per cent. of the Dutch railway system. The longest line is that between Rotterdam and Amsterdam (51 miles) and the shortest (5 miles), that between Haarlem and the seaside resort of Zandvoort. The lines are operated at 1,500 V DC, converted from 10,000 V, three-phase, at thirty-two automatically controlled mercury rectifier sub-stations with a total capacity of 66,800 kW. The rolling stock consists of 130 motor-equipped coaches and 149 trailing vehicles. Last year the electric trains are estimated to have covered a total of 7,812,500 train-miles and to have consumed power to the extent of about 130 million kWh.

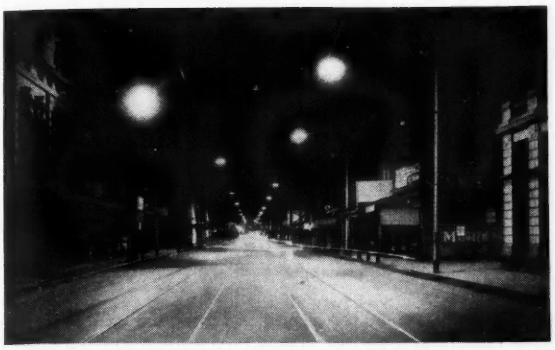
London.—TUBE STATIONS CLOSED.—Last Friday the L.P.T.B. announced the closing until further notice of the whole or sections of nineteen "Underground" stations. On the Northern Line there are at present no trains between Kennington and the Strand.

Switzerland.—POWER FOR MOUNTAIN RAILWAY.—The traffic on the electric railway to the summit of the Jungfrau mountain having in recent years exceeded all expectations, the capacity of the operating company's own generating plant is no longer sufficient to furnish the necessary quantity of power required. To meet the deficiency a new substation has recently been erected at Lutschental to take the necessary supplies from the distribution system of the Société

des Forces Motrices Bernoises. The railway is operated on a 50-cycle system while the frequency of the Bernoises system is 40 cycles. A special 1,600 kW three-phase ionic rectifying valve has, therefore, been installed; a description of this apparatus is given by M. E. Kern in a recent issue of the *Bulletin* of the Swiss Association of Electrical Engineers.

Street Lighting in Australia

A NOTABLE piece of work in public street lighting has recently been completed in a northern suburb of Melbourne, reports an Australian correspondent. Ninety-five Philips "Philora" sodium lamps have been installed on the one-and-a-half-mile section of Sydney Road that passes through Brunswick, an important industrial area of Melbourne.



New lighting in Brunswick, a northern suburb of Melbourne, Victoria. The light on the left is a spotlight directed on to the Town Hall clock

The type of road and the area it serves created many difficulties. The old system of lighting was of a mixed and patchy nature, having values of only 0.04 to 0.5 ft. candles. The minimum values of the new lighting are approximately 0.2 ft. candles at the kerb furthest from the lamp, and 2 ft. candles beneath the lamp.

The multiplicity of poles made it inadvisable, and in some cases impossible, to erect others. The method of suspension adopted is by wires from three convenient points, two on the same side as the lamp and one on the opposite side. The locally made fittings are attached to substantial ball joint assemblies, the arms from which are connected to the suspension wires.

No standardisation of fixtures was possible, every point needing individual attention. A uniform height of the lamps of 30 ft. and an even spacing of approximately 90 ft. were the chief requirements, and to obtain these, power line poles, tramway poles of varying heights, 26 to 32 ft., and the walls of buildings, had to provide the fixing points for the suspension wires.

The minimum height for anchoring the suspension wires had to be 32 ft. The lengths of these supporting wires varied from 16 ft. to 112 ft. The standard height of the lamp and the sag of the suspension wire determined the true height of the anchor point.

More than 280 fixing points were provided for the suspension wires, sometimes three, two or one only for each pole extension and fixture. Altogether 111 tramway poles, 43 power line poles, and 32 wall brackets were used for the network of supporting wires, and great care had to be exercised because of their proximity to power and tramway cables; 15,495 ft. of galvanised wire was used in this system of supporting the lamps and fittings.

The change over to the new form of lighting was made the occasion for the commencement of the Brunswick centenary celebrations. The city electrical engineer, Mr. T. F. Whitelaw, A.M.I.E. (Aust.), well-known in Australian electrical circles, has had charge of the Department for 8½ years. Educated at Melbourne Technical School, he served 25 years in the service of the Melbourne City Council Electrical Department, and was overhead line superintendent there before joining Brunswick. He is the only remaining original examiner of wiremen, and is immediate past-president of the Illuminating Engineering Society of Australia.

Large Electric Bakery

Interesting Swiss Installation

AN all-electric bakery recently established by the Winterthur Consumers' Co-operative Society in Switzerland has some unusual features. The most interesting individual piece of apparatus is an oven of 160-kW connected load, of the Turnus type. Other apparatus includes a smaller oven of 84 kW and miscellaneous cooking, heating and refrigerating installations.

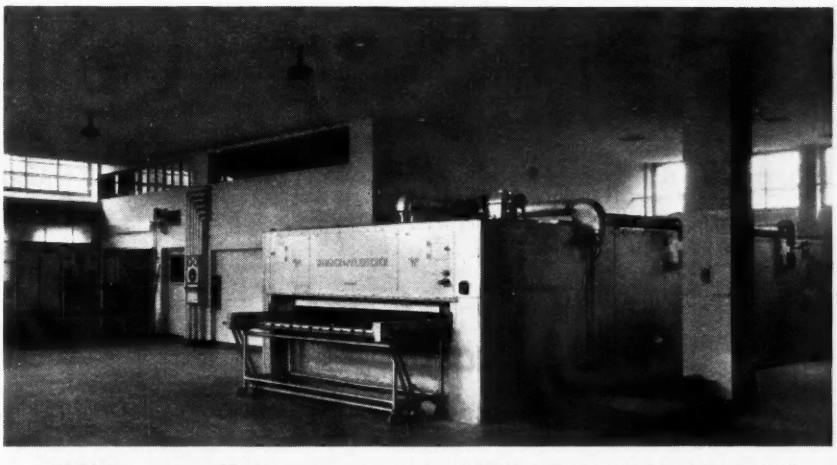
The larger oven is of a new type. It is approximately 10 metres long, 3.75 metres wide and 2 metres high. Unlike the ordinary construction, it does not contain any refractories, being of all sheet steel construction, inside and out, with the space between the inner and the outer layer of sheets filled with slag wool. Inside there are upper and lower baking tunnels through which an endless chain carries a series of 31 plates upon which the loaves are laid for baking. Each of these plates is capable of carrying from 12 to 14 loaves.

When the loaves have nearly reached the front end of the lower tunnel, the hanging pans pass over an automatic tipping device, which inclines the plates, so that the loaves slide off and drop on to a belt transporter that is built under the floor of the oven.

The endless chains are driven by a 1.5-HP motor, mounted on the top of the oven; operation of the motor can be controlled to permit the time of baking to be regulated from 15 to 90 minutes by means of a Ferrari relay.

The oven is heated by tubular elements of various "unit" capacities, arranged irregularly at the top and bottom of each of the two baking tunnels. The elements are designed to provide definite graduation of temperature throughout the length of the ovens.

A system of interlocking control is designed to provide twelve different possible degrees and distributions of heat, each arrangement being controlled by a single regulator which acts on the individual heating elements through relays. For preheating the oven one-third of the elements are switched on for about an hour before the oven is required rather than full capacity for a shorter time. The smaller oven is of more usual construction.



160-kW oven in a Zurich bakery with the 84-kW equipment in the background

Control of Wireless Telegraphy

THE Postmaster-General has given notice that it is considered expedient that the Government should have control over the transmission of messages by wireless telegraphy, and that the use of wireless telegraphy on board foreign ships while in the territorial waters of Great Britain and Northern Ireland should be subject to the regulations made by the Admiralty.

NEW BOOKS

AC Fundamentals. Meter Operation and Testing. Industrial Electricity

Alternating-Current Circuits. By J. Myron Bryant, J. A. Correll and E. W. Johnson. (Pp. 522; figs. 319.) London: McGraw-Hill Publishing Co., Ltd., Aldwych House, London, W.C.2. Price: 25s.

This is the third edition of a book published originally in 1925 and written by the first two named authors, Prof. Correll, we note with regret, having died.

Probably more books have been written on AC circuit theory than on any other subject, so that to achieve and maintain a noteworthy position in the current literature, a work to-day needs to be exceptionally good. The present volume is one of these—it even starts off well!

The first chapter relates to Faraday's Law and the general relations of EMF, current and flux in AC circuits. Then follow studies of various forms of series circuits, vector representation of waves and equations, and analyses of parallel circuits. Power is the subject of Chapter V and complex AC circuits, of Chapter VI. The latter is rather brief, but sound. Three-wire circuits are dealt with next, the authors introducing the subject by a preliminary study of DC circuits.

The next three chapters are concerned with polyphase circuits, and in Chapter XI the authors compare the amounts of conductor material required for different systems on the basis of the same EMF to neutral, the same EMF between outers, and the same EMF to neutral for the four-wire, three-phase system as between single-phase conductors. More advanced work is reached in Chapters XII to XV, which deal with transmission line constants and the calculation of short, medium length and long transmission lines by well-known methods. A study of non-sinusoidal wave forms completes the test.

Problems are included at the end of each chapter for class use, or private study. The book is excellent in conception and execution and it provides a first-class guide to a thorough study of AC fundamentals.—S. A. S.

Electricity Meters and Meter Testing. By G. W. Stubbings. (Pp. 213; figs. 62.) Chapman & Hall, Ltd., 11, Henrietta Street, London, W.C.2. Price: 12s. 6d.

It is indicative of the importance of the subject that it has been found necessary to devote a complete volume to meter testing in the series of Monographs on Electrical Engineering edited by H. P. Young. With the first-class testing apparatus which it is now compulsory for every undertaking to possess, the Class A testing stations will hold a master key which will facilitate entry into the many branches of electrical distribution, not excluding the sales departments. While all meter engineers must be familiar with the general comments in Chapter I it would equally be correct to say that any sales engineer assistant who digests the information contained in this chapter will double his value when negotiating for load development.

Chapter II explains, with diagrams, the operation of AC and DC meters, including methods of measuring reactive kVAh, which incidentally form part of the system of charging adopted by the Central Electricity Board. In addition, the author has described some "approximate methods of measuring three-phase energy" hitherto in use. This section will be found satisfying to those students who wish to check their knowledge of vector analysis as applied to meters. The reader must bear in mind, however, that the author has made it perfectly clear that certain modified constructions of single-phase meters are not approved by the Electricity Commissioners, and for this reason will probably not be manufactured in future. The general rule is that an AC meter should be constructed with n-I separate elements (where n is the number of wires to the supply), *viz.*, three-phase, four-wire would require three elements, and three-phase, three-wire, two elements.

Errors of measurement are dealt with in a most interesting manner, and will assist an examiner who has a sample meter submitted for tests in accordance with B.S.S. 37. When the author deals with standard and sub-standard instruments and explains the use of apparatus required for testing stations, he points out that there is one link of doubtful integrity between the certification of error of an AC sub-standard when referred back to the fundamental basis of measurement, namely, the EMF of a standard cell. The reader would do well to follow this information with that on pages 117-123, which will show a need for ensuring that sub-standard wattmeters for use on AC circuits and which are used as "transfer instruments" must not only give the same steady torque at any given position of the moving coil per VA in a DC circuit as they would per VA in an AC circuit at unity power factor, but they must also conform to true values when the power factor is varied in the measurement of AC energy.

In a passing reference to the use of slide rules the author mentions that each testing station should possess a rule of the Fuller type. This statement cannot be too widely published. It will be found, for instance, that with this rule it is possible to compute the errors as read on potentiometers sufficiently accurately to prepare a list of sub-standard accuracies without resorting to log tables, etc., and the calculations involved in standardising instruments will be greatly simplified.

The author continues with wide treatment of testing station equipment, and also meter testing technique in such conclusive fashion as to make the book a classic which can be thoroughly recommended. It should be mentioned that the penultimate line of page 183 contains an error which, in view of the statements made in the paragraph, should, we think, be corrected. Also 1,020 should read 1,002.—W. B. A.

Industrial Electricity.—By W. H. Timbie. 2nd ed. (Pp. 632; illus.) Chapman & Hall, Ltd., 11, Henrietta Street, London, W.C.2. Price: 15s.

In preparing this second edition the author has wisely deleted the sketchy account of electronic devices, and has utilised the space so saved to amplify the theory of DC machines. The text of the original edition has been thoroughly overhauled and largely rewritten, and in its present form the book gives a lucid and comprehensive account of elementary DC technology.

The author devotes a considerable amount of space to the calculation and measurement of resistances, but, in spite of some welcome amplification of the section on potentiometers, the treatment of other electrical measurements is still somewhat superficial. The portions dealing with the basic electromagnetic theory are very satisfactory, but we think that more might have been written about the remarkable series of magnetic alloys which has been developed since the book first appeared in 1924. There is no reference to modern permanent magnet alloys of high retentivity.

The chapters on the theory and characteristics of DC generators and motors are also very good, but the third-brush machine might have been dealt with a little more fully as this machine is very puzzling to elementary students. The author describes the paralleling of DC generators by the equal voltage method, but he does not mention the method by which zero voltage is obtained on the open switch terminals of the incoming generator.

The author is very successful in his use of a mechanical analogy for explaining the electrical properties of insulators, and there is a clear and adequate account of the chemical effects of electricity. Some changes seem to have been made to the very full selection of problems, and the answers to these problems, it seems from information in the book, are issued separately. Mr. Timbie's work can be thoroughly recommended to young engineers, and it will be particularly useful to those who are endeavouring to obtain a firm grasp of elementary theory by private study.—G. W. S.

The Electro-Chemistry of Gases and Other Dielectrics. By G. Glockler and S. C. Lind. (Pp. 469; figs. 81.) Chapman & Hall, Ltd., 11, Henrietta Street, London, W.C.2. Price: 30s.

Originally intended as one of a series of monographs to be published by the Conference on Electrical Insulation, the volume under review developed into a treatise on the chemical behaviour of gases and vapours in the electric field. Its authors have made a very comprehensive survey of the available literature on this subject and assembled it in a logical manner in this most informative volume. Not only so, but they have presented the general theories of the phenomena they discuss in a way which should prove valuable to workers on widely different aspects of gaseous conduction, and ionisation. Although its title suggests that the book is of primary interest to the chemist, the reader will find that the physical aspects of the subject are adequately discussed.

In Part I, the authors summarise typical reactions which occur under the influence of the glow, arc and corona discharges. The electro-chemical effects produced by cathode rays are dealt with after a comprehensive summary of high voltage discharge tube sources of these rays.

A considerable section of Part II is devoted to chemical reactions produced in organic substances under the influence of electrical excitation and a large amount of literature has been summarised. After a discussion of active nitrogen in Chapter 12, the remainder of this section deals with phenomena which occurs in compounds and elements which have atomic numbers between 8 and 82.

In Part III, the authors include discussions on various topics of physics which assist in a better understanding of the chemistry of discharge reactions and in this section Chapter 18 is devoted to ionisation produced during chemical reactions, an aspect of the subject which is both interesting and stimulating. The section on cathodic sputtering of metals is another example of the careful way in which voluminous literature has been summarised and condensed into a logical sequence.

Altogether, we consider Glockler and Lind's book to be a valuable contribution to the subject and to fill a gap in the literature on chemical reactions which occur under the stimulus of electric fields.—J. N. A.

FINANCIAL SECTION

New Companies. Returns of Capital. Debenture Charges. Bankruptcies and Liquidations. Reports of Electrical Companies. Dividend Announcements. Stocks and Shares

New Companies Registered

Masterphone & Electric Co., Ltd.—Private company. Registered September 1st. Capital, £1,000. Objects: To carry on the business of electrical, wireless and mechanical engineers, contractors and merchants, &c. S. H. Thirkell, of 87, West Street, Dunstable, is first director. Registered office: 114, Bury Park Road, Luton.

Ducellier Sales (Great Britain), Ltd.—Private company. Registered September 2nd. Capital, £200. Objects: To carry on agencies for import, export, purchase and sale of automobile and aircraft electrical equipment, particularly the products of Etablissements Ducellier Société Anonyme, of 23, Rue Alexandre Dumas, Paris XIe, France. Directors: R. E. Warlow, 7, Trevor Square, Knightsbridge, S.W.7, and B. Geleerd, Middensteiger 26-28, Rotterdam, Holland. Registered office: 7, Conduit Street, W.1.

Express Electrical Services, Ltd.—Private company. Registered September 2nd. Capital, £15,000. Objects: To carry on the business of manufacturers, sellers, hirers, repairers and cleaners of and dealers in magnetos, dynamos, starters, batteries and appliances of every kind, for ignition or starting in connection with internal combustion engines, &c. J. Batty, 27, Ecclesall Road South, Sheffield, signs as director. Solicitor: Robt. B. Grayson, 7, North Church Street, Sheffield, 1.

Mitchell Electric, Ltd.—Private company. Registered August 30th. Capital, £2,100. Objects: To carry on the business of electrical, mechanical and general engineers, manufacturers of and dealers in electrical and other apparatus, &c. Directors: W. R. M. Mitchell, 28, Knightlow Road, Harborne, Birmingham; W. Kupfer, 34, Eton Rise, Haverstock Hill, N.W.3; and A. Sadler, 115, Heywood Road, Prestwich, Manchester. Registered office: Meca Works, Five Ways, Birmingham.

Companies' Returns

Statements of Capital

Wickford and District Electricity Supply, Ltd.—Capital, £30,000 in £1 shares (1,500 7 per cent. preference and 28,500 ordinary). Return dated March 21st (filed July 21st). 1,500 preference and 16,500 ordinary shares taken up. £17,995 paid on 1,500 preference and 16,495 ordinary, £5 considered as paid on 5 ordinary. Mortgages and charges nil.

Marconi's Wireless Telegraph Co., Ltd.—Capital, £4,000,000 in 3,250,038 ordinary shares of 10s., 499,935 ordinary shares of £1, 3,250,092 ordinary shares of 10s. and 250,000 7 per cent. cumulative participating preference shares of £1 each. Return dated May 23rd, 1939. 3,250,038 ordinary of 10s., 395,114 ordinary of £1 and all preference shares taken up. £1,797,484 10s. paid on 3,094,969 ordinary and 250,000 preference, £472,648 10s. considered as paid on 155,069 ordinary and 395,114 £1 ordinary. Mortgages and charges nil.

Weston-super-Mare and District Electric Supply Co., Ltd.—Capital, £215,000 in 40,000 cumulative preference and 175,000 ordinary shares of £1 each. Return dated May 26th. All shares taken up. £100,000 paid on 40,000 preference and 60,000 ordinary, £115,000 considered as paid on remainder. Mortgages and charges nil.

Siemens Brothers & Co., Ltd.—Capital. £3,000,000 stock in £2,450,000 ordinary stock and £550,000 10 per cent. cumulative preference stock, in £1 units. Return dated June 2nd. All stock issued and fully paid up in cash. Mortgages and charges nil.

Power & Traction Finance Co., Ltd.—Capital. £250,000 in £1 shares. Return dated June 5th. 50,000 shares taken up. £28,001 paid, being £1 on 6,002 and 10s. on 43,998. Mortgages and charges nil.

E.K.C.O., Ltd.—Capital, £100 in 1s. shares. Return dated June 22nd. Two shares taken up. 2s. paid. Mortgages and charges nil.

Para Electric Railways & Lighting Co., Ltd.—Capital, £780,000 in £1 shares (390,000 preference and 390,000 ordinary). Return dated June 26th. 325,000 preference and 390,000 ordinary shares taken up. £25,040 paid on 25,000 preference and 40 ordinary, £689,960 considered as paid on 200,000 preference and 389,960 ordinary. Mortgages and charges: £529,046.

Calcutta Tramways Co., Ltd.—Capital, £1,400,000 in £1 shares (950,000 ordinary and 450,000 preference). Return dated May 23rd. 700,000 ordinary and 250,000 preference shares taken up. £764,900 paid, being 8s. per share on 22,000 ordinary, 10s. on 40,000 ordinary, 14s. on 110,000 ordinary and £1 on 409,100 ordinary and 250,000 preference. £185,100 considered as paid, being 12s. per share on 22,000 ordinary, 10s. on 40,000 ordinary, 6s. on 110,000 ordinary and £1 on 118,900 ordinary. Mortgages and charges, £247,500.

Anchor Cable Co., Ltd.—Capital, £250,000 in £10 shares. Return dated May 29th. 21,334 shares taken up. £79,340 paid on 7,934. £134,000 considered as paid on remainder. Mortgages and charges, nil.

Meifod Electricity Co., Ltd.—Capital, £100 in 400 5s. shares. Return dated June 8th. 40 shares taken up. £10 paid. Mortgages and charges, £1,000.

Ever Ready Co. (Great Britain), Ltd.—Capital, £1,500,000 in £200,000 7 per cent. cumulative participating preference stock, £1,010,402 5s. ordinary stock and 1,158,391 ordinary shares of 5s. each. Return dated June 15th. £200,000 preference stock and £1,010,402 5s. ordinary stock taken up. £579,958 5s. paid, being £98,000 preference stock and £481,958 5s. ordinary stock. £630,444 considered as paid, being £102,000 preference stock and £528,444 ordinary stock. Mortgages and charges, nil.

Clowne Electric Supply Co., Ltd.—Capital, £3,000 in £1 shares. Return dated June 21st. 3,000 shares taken up. £3,000 paid. Mortgages and charges, nil.

Callender's Cable and Construction Co., Ltd.—Capital, £2,300,000 in £1 shares (150,000 ordinary, 400,000 preference and 400,000 "B" preference). Return dated June 21st. 1,123,916 ordinary, 400,000 preference and 400,000 "B" preference shares taken up. £1,255,000 paid. £668,916 considered as paid. Mortgages and charges, £300,000.

General Accessories Co., Ltd.—Capital, £3,000 in £1 shares (1,580 6 per cent. preference, 920 5 per cent. preference and 500 ordinary). Return dated July 1st. All shares taken up. £1,580 paid on 1,580 6 per cent. preference. £1,420 considered as paid on remainder. Mortgages and charges, £17,000.

Revo Electrical Co., Ltd.—Capital. £500,000 in 10s. shares. Return dated July 5th. 735,000 shares taken up. £228,150 paid on 456,300. £139,350 considered as paid on 278,700. Mortgages and charges, nil.

Mortgages and Charges

Philco Radio and Television Corporation of Great Britain, Ltd.—Mortgage debenture charged on deeds and documents relating to properties at Perivale, Greenford, Mdx, 500 fully paid shares of £1 each in Dyer Estates, Ltd., and the company's undertaking and other property, present and future, including uncalled capital, dated August 16th, 1939, to secure all moneys due or to become due from the company to Lloyds Bank, Ltd.

Osborn Manufacturing Co., Ltd.—Particulars filed of debentures not exceeding £10,000 authorised July 26th, 1939, charged on the company's property, present and future, including uncalled capital, the amount of the present issue being £10,000.

A. O. Gibbons, Ltd.—Particulars filed of (a) first debentures to secure not more than £700 with a premium of 3 per cent., and (b) second debentures to secure not more than £2,000 with a premium of 10 per cent. authorised August 10th, 1939, charged on the company's property, present and future, including uncalled capital, the amounts of the present issues being £700 and £1,300 respectively.

Ernest F. Moy, Ltd.—Deposit on August 15th, 1939, of deeds of 116 to 134 (even numbers), Bayham Street, and workshops at rear of 23 to 43 (odd numbers) Caroline Street, St. Pancras, N.W., to secure all moneys due or to become due from the company to Westminster Bank, Ltd.

Decca Radio & Television, Ltd.—Issues on (a) August 3rd of £2,500, (b) August 4th of £1,000, and (c) August 17th, 1939, of £100 notes, part of a series already registered.

Synchronome Co., Ltd.—Particulars filed of debentures not exceeding £12,000 authorised August 8th, 1939, charged on the company's property, present and future, including uncalled capital, the amount of the present issue being £8,300.

Lomax & Samways, Ltd.—Mortgage on all moneys payable in respect of certain hire-purchase agreements and full benefit thereof, dated August 11th, 1939, to secure £300. Holders: H.G.R., Ltd., St. Petersgate, Stockport.

Increases of Capital

Adelaide Electric Supply Co., Ltd.—The nominal capital has been increased by the addition of £250,000 beyond the registered capital of £3,375,000. The additional capital is divided into 250,000 5 per cent. "D" cumulative preference shares of £1 each.

Kingson's, Ltd.—The nominal capital has been increased by the addition of £500, in £1 ordinary shares, beyond the registered capital of £1,000.

Automatic Internal Telephones, Ltd.—The nominal capital has been increased by the addition of £2,500, in £1 shares, beyond the registered capital of £2,500.

Tomlinson (Electric Vehicles), Ltd.—The nominal capital has been increased by the addition of £2,000 beyond the registered capital of £2,000. The additional capital is divided into 100 preference shares of £1 and 38,000 ordinary shares of 1s. each, ranking, pari passu, with existing shares.

Receiver Released

Belshaw & Co., Ltd. (old company).—G. F. R. Baguley, of 4b, Fredericks Place, Old Jewry, E.C., ceased to act as receiver and/or manager on June 30th, 1939.

Company Liquidations

John Lightfoot, Ltd.—Particulars of claims by September 21st to the liquidator, Mr. W. P. Masterson, Bank of England Chambers, Tib Lane, Manchester This notice is given to comply with the requirements of the Companies Act. All creditors have been or will be paid in full.

Coulphone Radio Manufacturing Co., Ltd.—Meetings, October 2nd, at 2, Chapel Street, Preston, to receive an account of the winding-up by the liquidator, Mr. S. R. Aldrich.

Ever Ready Electric Carbon Co., Ltd.—Winding up voluntarily. Liquidator, Mr. J. W. Molineaux, 49, Queen Street, Wolverhampton.

Mackallen Heating Co., Ltd.—Winding

(*Concluded at foot of next page.*)

STOCKS AND SHARES

TUESDAY EVENING.

BUSINESS was resumed on a limited scale this (Tuesday) morning. It was possible to deal in the shares of a good many companies but at prices lower, as a rule, than those current last week. The quotations given in our lists are, to a great extent, nominal. They are taken from the last-published Stock Exchange Official List, Thursday, August 31st. For practical purposes, it may be said that the ordinary and preference shares of the electricity supply companies are about a florin below the official figures. British Electric Traction deferred changed hands to-day at 800. Dollar stocks are mostly well up on last week's prices.

Stock Exchange Closed

As it happened, the decision to close the Stock Exchange had already been taken by the time hostilities began in Poland. The actual reason was the Government's action in putting the evacuation plans in motion on the Friday before the emergency itself, it being desired not to impede those plans in any way. Originally, it was hoped to reopen the House on Monday this week, but this proved to be impracticable, and it was finally decided to reopen on Thursday. It is recalled that after the closure in 1914, the House remained shut for the rest of the year. On that occasion, however, the emergency disclosed financial complexities vastly greater than any which will now arise.

War Finance

It is supposed that the raising of a large-scale Defence Loan will be among the earliest events on the resumption of Stock Exchange business. In the House of Commons, authority has been given for a £500 millions credit for expenditure in "ensuring the public safety and defence of the Realm." The same Bill removed the limit of £550 millions set to the amount that might be issued to the Exchange Equalisation Account, the equivalent of which had to be created at the beginning of the last war. A large national loan would find a ready response from people glad to have such opportunity for the furtherance of the national interest.

Provision of the extra funds wanted to prosecute a war will not, it seems safe to assume, be left to borrowing alone. Increases in taxation, direct or indirect, will doubtless play their part. The Chancellor of the Exchequer, in answering a question as to whether he contemplated introducing a new Budget within a few days, said that arrangements were being made necessary in the emergence of a sudden situation. Speaking without having had the opportunity of considering all the implications, the Chancellor said it certainly did appear that further provision would need to be made on those lines.

Temporary Accommodation

In case the City should become unhealthy, the Stock Exchange authorities have secured limited accommodation elsewhere for housing, if necessary, the official departments, and, perhaps, for the provision of a meeting place to serve the purpose of a market. Many Stock Exchange firms have themselves fixed on temporary premises in the country where essential records can be stored and from which business would be conducted. These firms have, in a number of cases, notified clients of an address where they could receive communications. Members and firms have been advised to provide the Stock Exchange Committee with addresses where they can be kept in touch with the Committee's decisions and arrangements.

Foreign Holdings

Foreign currency, to be used in the purchase of essential commodities, will be ammunition of great service to the Government in the prosecution of the war. The value of currencies and other foreign securities held by residents in this country is estimated at a gigantic figure. In order that this reserve may be readily available when needed, these holders are now obliged to provide the Bank of England with full particulars before September 26th. Forms for the purpose of the return are to be obtained from all banks and stockbrokers. Securities concerned are those for which the principal, the dividends or interest are payable in the currency of the United States, Canada, Argentina, France, Belgium, Holland, Norway, Sweden, Switzerland and the Dutch East Indies. Meanwhile, such stock cannot be sold without the Treasury's sanction. This obligation was another of the precautionary measures taken in advance of the emergency. When the time comes for the mobilisation of foreign currencies, it may be that holders will have the choice of selling the securities outright, at some selected level of prices, to the Government or of accepting Government stock in exchange.

"Open" Bargains

One of the most serious market difficulties of the situation in 1914 was created by the unwieldy proportions of the open speculative position. In other words, the settlement of a vast number of bargains was being carried over from one Stock Exchange account to the next, many buyers and sellers having no intention of paying for or, as the case might be, of delivering the stock concerned. The difficulty of closing such positions in 1914 was amongst the chief reasons for the long delay in reopening the doors of the House for business. On the present occasion, the drawn-out tension had virtually dried up speculation long before matters came to a head. The negligible size of the speculative position is, accordingly, one of the several points of advantage in the present state of affairs, as compared with that of 1914, and no doubt a reason for the early opening of the Stock Exchange. For such bargains as are outstanding—and there was a rather surprising volume of business in the days leading up to the climax—the settlement has been postponed from Thursday of this week to a fortnight later.

Then and Now

Past experience may be no guide, but people seeking a clue as to the future development of Stock Exchange affairs are recalling the course of events through the last war years. As already mentioned, it was found necessary to keep the House shut for five months—from the end of July to the beginning of January. Business began again on very tentative lines. Slowly, however, minds became accustomed to the changed conditions. Many industries became tremendously active. Companies made good profits—despite the rise in income-tax and the appearance of E.P.D.—and paid good dividends. There was money to spend; there were savings to invest. The capital market was pressed for the accommodation of industrialists compelled to expand their plant. In short, the conditions had some resemblance to those which make for active share markets. And the markets responded to a quite appreciable extent.

Course of Prices

Prices gave way all round in 1914 and 1915. Quotations for gilt-edged securities failed to retrieve their previous positions, the yield on "old" Consols rising by about 1 per cent. over the war period. Many ordinary shares, on the other hand, found the circumstances favourable. Results were, of course, uneven. But according to the statistics kept for those years, the average price of industrial ordinary shares finished the war well above the 1913 level. In some cases, noticeably with such industries as shipping and engineering, the appreciation was of a substantial order. Commodity prices rose steeply, and the inflationary atmosphere was, of course, conducive to strong share prices. Events followed on the same course after 1918, developing into unhealthy boom, followed by the pricking of the inflated bubble in 1920. Since those days, however, the authorities have learnt many lessons in the art of controlling monetary and market affairs. In the matter of floating loans without at the same time damaging gilt-edged prices, for instance, the Treasury has developed a highly effective technique.

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up voluntarily. Liquidator, Mr. F. E. Bendall, 4, Charterhouse Square, E.C.1.

Bankruptcy Proceedings

A. Leach, radio dealer, now residing at 79, Colham Avenue, Yiewsley, Middx.—Discharge suspended for three months until September 14th, 1939.

W. T. Dalton, wireless engineer, 62, East Street, Horsham.—Last day for receiving proofs for dividend September 12th. Trustee, Mr. A. E. Orbell, 6 and 7, Old Steine, Brighton.

A. Parsons, electrician, 23, Clifton Crescent South, Rotherham.—First and final dividend of 6s. 2d. in the £, payable at Queen's Buildings, Queen Street, Sheffield.

A. H. Estall, electrical contractor, 20, Thackeray Street, Kensington, W.8. Trustee, Mr. W. A. J. Osborne, Balfour House, Finsbury Pavement, London, E.C.2, released August 24th. 1939.

Reports and Dividends

Ultra Electric (Holdings), Ltd., reports a trading loss for the year ended April 30th of £42,534, and, after providing for depreciation, £7,373, written off investment in subsidiary, £3,096, and expenditure on patents, £25, there is a deficit of £53,028. The debit brought in was £25,307, and after adding income tax the debit carried forward is £85,428. The report states that the radio season of 1938-39 was poor. Shrinkage of demand made it necessary to restrict production further, but in spite of substantial economies it was impossible to avoid the bad trading results. During the last six months of the financial year the company equipped itself for work other than radio, and in this connection a considerable amount of plant and equipment has been installed. While results were small for the period to April 30th, since that date the contracts side has rapidly expanded. On the radio side, plans for the coming season have been made on a conservative basis. The company's new models have been well received, and the demand prior to the present crisis was encouraging. Television business is gradually extending, and the company's new models have a high standard of performance. The operations of the subsidiary in Belgium resulted in a loss for 1938.

The Philco Radio & Television Corporation of Great Britain, Ltd., has issued a circular to shareholders in which it states that as a result of negotiations with the company's American creditors, the Philadelphia Storage Battery Co., and its associates in the United States, the full discharge of debts amounting to £77,114 has been secured by the payment in cash of £50,000. In order to provide the necessary cash for the debt settlement and additional funds to finance new work, the company's bankers have agreed to make temporary advances. The existing agreements between Philco Radio and the American company relating to technical services and reciprocal use of all present and future patents, designs and processes have been strengthened.

The Globe Telegraph & Trust Co., Ltd., is paying a quarterly dividend of 1¼ per cent., net (same).

The Greengate & Irwell Rubber Co., Ltd., has declared an interim ordinary dividend of 1s. 3d. per share, or 7$^{15}/_{16}$ per cent. (against 9d., or 4$^{11}/_{16}$ per cent.).

ELECTRICAL COMPANIES' SHARES

Prices, Dividends and Yields

Company	1939 High-est	1939 Low-est	Dividend Pre-vious	Dividend Last	Price Aug. 31	Rise or Fall	Yield p.c. £ s. d.
Home Electricity Companies							
Bournemouth and Poole	68/3	60/–	15	15	60/–	—	5 0 0
British Power and Light	30/9	25/–	7	7	25/6	—	5 9 10
City of London	33/9	29/6	7½	7½	29/6xd.	—	5 1 8
Clyde Valley	37/9	34/–	8	8	35/–	–9d.	4 8 4
County of London	46/9	39/–	10½	10½	39/6	—	5 18 0
Edmundson's:							
7% Pref.	31/6	30/–	7	7	29/6	–6d.	4 15 0
Ord.	27/9	23/–	9	6	23/6	—	5 2 2
Elec. Dis. Yorkshire	41/6	37/9	9	9	38/9	—	4 16 9
Elec. Fin. and Securities	47/9	45/–	12½	12½	47/6	—	5 5 3
Elec. Supply Corporation	51/9	47/6	12	12	47/–	—	5 2 1
Isle of Thanet	20/–	18/6	4	4	18/6	—	4 6 6
Lancs Light and Power	34/6	29/–	7½	7½	30/–	—	5 0 0
Llanelly Elec.	22/6	20/6	5½	5½	20/6	—	5 7 4
Lond. Assoc. Electric	30/–	23/9	7	7	23/9	—	5 18 0
London Electric	34/3	31/–	7	7	31/3	—	4 6 2
London Power Deb. Red.	106½	101½	5	5	101½	–½	4 18 6
Metropolitan	51/–	43/6	12	12	43/9	—	5 10 1
Midland Counties	38/9	34/–	8	8	37/6	—	4 5 4
Mid. Elec. Power	41/9	38/3	8	9	39/6	—	4 11 2
Newcastle Elec.	28/9	26/6	7	7	27/–	—	5 3 8
North Eastern Electric:							
Ordinary	32/3	28/6	7	7	28/6	–6d.	4 18 3
7% Pref.	32/6	30/–	7	7	30/6	–6d.	4 11 10
Northampton	48/–	45/–	10	10	45/–	—	4 9 0
Notting Hill 6% Pref. (£10)	13½	12½	6	6	12½	—	4 14 1
Northmet Power:							
Ordinary	46/6	41/–	10	10	41/3	—	4 17 0
6% Pref.	29/–	24/6	6	6	24/6	—	4 18 0
Richmond Elec.	29/–	26/3	7	7	26/3	—	5 6 10
Scottish Power	38/9	33/9	8	8	32/6	—	4 18 0
Southern Areas	22/9	19/–	5	5	19/–	—	5 5 3
South London	30/9	26/3	7	7	26/3	–3d.	5 6 8
West Devon	23/3	21/3	5	5	21/3	—	4 14 1
West Glos.	21/3	17/3	2	2½	17/6	—	2 17 2
Yorkshire Elec.	38/6	34/9	8	8	35/–	—	4 11 4
Overseas Electricity Companies							
Atlas Elec.	4/3	2/–	Nil	Nil	2/–	—	—
Calcutta Elec.	39/–	28/3	10*	10*	28/6	–6d.	—
Cawnpore Elec.	34/6	28/3	10	10	28/3	—	—
East African Power	26/3	22/–	7	7	22/–	—	6 16 4
Jerusalem Elec.	24/6	22/–	7	7	22/–	+2/–	6 17 3
Kalgoorlie (10/–)	10/6	9/6	7½	7	10/–	—	7 0 0
Madras	31/–	21/3	8*	8*	21/3	—	—
Montreal Power	35½	31	1½	1½	34	—	—
Palestine Elec. "A"	29/6	20/–	7½*	5*	20/–	—	5 0 0
Perak Hydro-electric	18/9	13/6	7	6	13/9	—	8 14 6
Shawinigan Power	23½	20	85cts.	83cts.	22	—	—
Tokyo Elec. 6%	61	37	6	6	37½	—	16 0 0
Victoria Falls Power	73/9	60/–	12½	15	65/–	–½	4 12 4
Whitehall Investments Pref.	19/6	15/–	7½	7½	15/–	—	10 0 0
Public Boards							
Central Electricity:							
1950–70	112	103	5	5	103	—	4 17 1
1955–75	115½	107	5	5	107	—	4 13 6
1951–73	106½	101	4½	4½	101	—	4 9 0
1963–93	95½	84	3½	3½	84	—	4 3 4
London Elec. Trans. Gtd.	88½	83	2½	2½	83	—	2 19 6
London & Home Counties							
1955–75	107½	105	4½	4½	105½	—	4 5 6
Lond. Passenger Transport:							
A	114½	103	4½	4½	103	—	4 7 5
B	117½	102	5	5	102	—	4 18 0
C	83½	64½	4½	4	65	—	6 3 1
West Midland Joint Elec.,							
1948–68	112½	107	5	5	107	—	4 13 6
Telegraph and Telephone							
American Tel. & Tel.	182½	159	9	9	182½	+10	4 18 8
Anglo-Am. Tel.:							
Pref.	101½	89½	6	6	92½	—	6 9 9
Def.	23¾	19	1½	1½	21	—	7 2 10
Anglo-Portuguese	24/–	19/9	8	8	20/9	—	7 14 2
Cable & Wireless:							
5½% Pref.	95½	75	4½	5½	85½	+½	6 8 8
Ord.	55	34	4	4	49½	+3	8 1 8
Income	100	95½	—	—	97	—	4 2 6
Canadian Marconi $1	5/6	3/9	—	Nil	4/3	—	—
Globe Tel. & Tel.:							
Ord.	31/3	23/6	7½*	7½*	30/–	—	5 0 0
Pref.	26/9	23/3	6	6	23/9	—	5 1 1
Great Northern Tel. (£10)	38	27½	20	20	28	—	7 7 10
Inter. Tel. & Tel.	10½	6⅛	Nil	Nil	7⅛	+1	—
Marconi-Marine	30/–	23/–	7½	10	27/6	—	7 5 6
Oriental Telephone Ord.	2½	46/3	12*	12*	2 7/16	—	4 16 0
Radio Corpn.	8⅛	5⅜	8	6	5½	–⅜	—
Telephone Props.	14/–	12/9	5	6	13/9	—	8 14 6
Telephone Rentals (5/–)	10/–	8/6	10	10	8/6	–9d.	5 17 8
Western Union	28	19½	2¾	—	23½	—	—
Traction and Transport							
Anglo-Arg. Trams:							
First Pref. (£5)	7/6	3/6	Nil	Nil	3/9	—	—
4% Inc.	16	7	Nil	Nil	7½	—	—
British Electric Traction:							
Def. Ord.	1025	700	5	5	850	+50	—
Pref. Ord.	164	150	8	8	150	—	5 3 3
Bristol Trams	52/6	37/3	8	10	49/6	+9d.	4 0 10
Brazil Traction	13	7⅞	$1	50c.	7⅞	–⅛	—
Calcutta Trams	25/6	22/–	8	8	23/6	–6d.	6 16 2
Cape Elec. Trams	18/–	16/9	5	6	17/6	—	6 17 2
Lancs Transport	37/9	32/6	10	10	36/–	—	5 11 1
Mexican Light:							
1st Bonds	25	20	5	5	20	—	—
Rio 5% Bonds	81	47	5	5	65	—	7 9 3
Southern Rly:							
5% Prefd.	75½	48	5	5	58	+1	8 12 4
5% Pref.	99½	79	5	5	80	+1	6 5 0
T. Tilling	2½	39/6	10	10	45/–	—	4 5 2
Tilling & B.A.	54/6	50/–	10	9*	53/9	—	3 7 0
West Riding	37/9	31/3	10	10	35/–	–1/16	—
Equipment and Manufacturing							
Aron Electricity Ord.	32/3	28/9	15	15	30/–	—	10 0 0
Assoc. Elec.:							
Ord.	45/3	34/9	10	10	39/–	+1/–	5 2 7
Pref.	36/6	34/–	8	8	35/–	—	4 11 5
Automatic Telephone & El.	47/6	39/3	10	12½	43/9	—	5 14 3
Babcock & Wilcox	48/–	37/–	10	12½	45/9	—	5 9 3
British Aluminium Ord.	58/9	48/9	12½	12½	56/3	+6d.	4 9 0
British Insulated Ord.	88/–	77/–	20	20	83/9	—	4 15 10
British Thermostat (5/–)	16/–	12/–	18½	18½	13/9	—	6 14 7
British Vacuum Cleaner (5/–)	22/6	14/–	40	40	15/–	—	—
Brush Ord.	5/9	4/6	Nil	Nil	5/–	—	—
Callender's	92/–	60/–	20	15	60/–	—	5 0 0
Chloride Elec. Storage	82/3	62/6	20	15	3 1/16	—	4 10 4
Consolidated Signal	96/–	80/9	36½	36½	82/6	—	8 16 9
Crabtree (10/–)	25/6	21/6	17½	17½	22/6	—	7 15 4
Crompton Parkinson:							
Ord. (5/–)	21/–	14/9	12½	15	17/6	—	—
E. K. Cole (5/–)	9/–	4/–	10	Nil	4/6	—	—
Elec. & Musical Industries (10/–)	14/9	8/9	10	5	9/6	–3d.	5 5 3
Electric Construction	38/6	30/6	12½	13½	35/–	—	7 14 3
Enfield Cable Ord.	58/6	48/6	25	16½	50/–	+1/16	6 10 0
Electrical Switchgear (10/–)	27/–	23/9	16	16	23/9	—	6 14 9
English Electric	36/6	30/3	10	10	34/6	+6d.	5 16 0
Ensign Lamps (5/–)	16/9	13/9	—	25	15/9	—	7 18 3
Ericsson Tel. (5/–)	43/–	35/–	25*	25*	41/3	—	3 0 8
Ever Ready (5/–)	24/–	18/–	35	30	18/6	+6d.	8 2 2
Falk Stadelmann	27/–	18/9	10	6	18/9	—	6 8 0
Ferranti Pref.	25/6	22/6	7	7	23/–	—	6 1 9
G.E.C.:							
Pref.	31/9	29/3	6½	6½	31/3	—	4 3 2
Ord.	82/–	70/9	17½	20	75/–	+1/6	5 6 8
Greenwood & Batley	27/6	24/6	7	15	26/3	—	11 9 0
Hall Telephone (10/–)	22/3	19/3	15	15	20/–	—	7 10 0
Henley's (5/–)	21/–	17/3	20	20	17/6	—	5 14 3
4½% Pref.	23/–	21/–	4½	4½	21/3	—	4 4 8
Hopkinsons	46/3	37/3	12½	15	43/9	—	6 17 7
India-Rubber Pref.	21/3	20/–	5½	5½	20/–	—	5 10 0
Intl. Combustion	120/–	97/–	32½	32½	5 1/16	—	5 14 5
J. Lucas	60/–	52/–	15	15	58/9	+1/16	5 2 2
Johnson & Phillips	41/3	32/–	12½	12½	38/9	—	6 8 10
Lancashire Dynamo	68/–	57/6	25	25	60/–	—	8 6 8
Laurence Scott (5/–)	12/–	10/–	15	15	10/–	–3d.	7 6 4
London Elec. Wire	31/6	28/6	12	7½	28/9	—	5 4 4
Mather & Platt	50/–	42/6	13½	13½	43/9	—	6 3 3
Metropolitan Elec. Cable Pf.	21/3	21/–	5½	5½	21/3	—	5 3 6
Murex	85/9	63/9	20	20	77/6	—	5 3 1
Pye Deferred (5/–)	13/9	7/6	25	25	8/–	—	15 12 6
Revo (10/–)	35/6	26/–	17½	17½	26/3	—	6 13 7
Reyrolle	61/–	52/6	12½	12½	56/3	—	4 9 0
Siemens Ord.	26/9	20/6	7½	7½	21/3	—	7 1 2
Strand Elec. (5/–)	5/3	3/9	5	10	3/9	—	3 6 8
S. Smith (1/–)	9/	6/–	37½	50	7/6	+1/16	6 13 4
Switchgear & Cowans (5/–)	15/–	11/3	20	20	12/–	—	8 6 8
Telegraph Condenser (10/–)	7/6	5/–	5	—	7/6	—	—
Telegraph Construction	2⅛	37/6	10	10	38/9	—	5 3 1
Telephone Mfg. (5/–)	10/–	8/–	9	9	8/6	—	5 6 0
Tube Investments	91/–	82/9	23¾	23¾	86/3	+1/16	5 11 0
Vactric (5/–)	4/3	2/3	10	4	2/3	—	8 18 0
Vickers (10/–)	24/6	16/3	10	10	17/9	+6d.	5 12 8
Ward & Goldstone (5/–)	22/6	19/6	20	20	19/9	—	5 1 3
Westinghouse Brake	54/9	43/9	17½	17½	47/6	—	7 7 6
Walsall Conduits (4/–)	31/9	24/–	55	55	24/6	—	8 19 6
West, Allen (5/–)	7/6	5/9	7½	10	5/9	—	8 14 0

* Dividends are paid free of Income Tax.

NEW PATENTS

Electrical Specifications Recently Published

Compiled by a firm of chartered patent agents. The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (1s. each) can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1937

30191. "Electron-discharge devices." J. D. McGee and H. G. Lubszynski. November 4th, 1937. (510696.)

30265. "Stabilising arrangement for valve amplifying apparatus." L. L. De Kramolin. November 5th, 1936. (510941.)

33520. "Electro-magnetically operated tools of the percussion type." J. E. Pollak (M. Greiner). December 3rd, 1937. (510806.)

33587. "Electron-discharge devices such as cathode-ray tubes." O. Klemperer and F. H. Nicoll. December 4th, 1937. (510699.)

36182. "Electro-acoustic devices." H. J. Houlgate, G. C. Wheeler and G. R. Fountain, Ltd. December 31st, 1937. (511034.)

1938

214. "Electron-discharge devices." F. H. Nicoll and B. J. Mayo. Jan. 4th, 1938. (Cognate app. 28026/38.) (510702.)

255. "Thermionic valves." E. Y. Robinson and Metropolitan-Vickers Electrical Co., Ltd. January 4th, 1938. (510703.)

661. "Electric circuits including transformers, chokes, or the like." Allgemeine Elektricitäts-Ges. January 8th, 1937. (510787.)

3573. "Thermionic valve cyclic control arrangements." Standard Telephones & Cables, Ltd., and E. W. Braendle. February 4th, 1938. (510710.)

3575. "Electron-discharge devices." Standard Telephones & Cables, Ltd., and D. H. Black. February 4th, 1938. (510712.)

3582. "Television receivers." Kolster-Brandes, Ltd., and C. N. Smyth. February 4th, 1938. (510715.)

3644. "Electrical transmission of intelligence." Allgemeine Elektricitäts-Ges. February 4th, 1937. (510720.)

3766. "Balancing and compensating arrangements for two-phase installations." Soc. Savoisienne de Constructions Electriques. February 9th, 1937. (511037.)

3782. "Electrical signalling systems." Automatic Telephone & Electric Co., Ltd., and P. N. Roseby. February 7th, 1938. (510792.)

3813. "Methods of producing electrical oscillations." Baird Television, Ltd., and T. C. Nuttall. February 7th, 1938. (510881.)

3839. "Rheostats and potentiometers." International Resistance Co. February 19th, 1937. (510796.)

3927. "Apparatus for measuring electric resistance, particularly insulation resistance." Standard Telephones & Cables, Ltd., and H. S. Leman, and E. W. Jordan. February 8th, 1938. (510801.)

4027. "Impulse senders of the type used in telephone systems." J. D. Hinchcliff. February 9th, 1938. (510951.)

4032. "Electrical measuring instruments." E. H. W. Banner. February 9th, 1938. (510885.)

4064. "Electric condensers." Dubilier Condenser Co. (1925), Ltd., and N. C. Moore. February 9th, 1938. (511042.)

4068. "Electrical signalling systems, for use in the protection of power lines." Automatic Telephone & Electric Co., Ltd., and T. B. D. Terroni. February 9th, 1938. (511136.)

4091. "Electric radiators." H. H. Berry and W. J. Markham. February 9th, 1938. (510807.)

4092. "Regulator machines for use with rotary transformers of the kind known as metadyne transformers." A. Tustin, and Metropolitan-Vickers Electrical Co., Ltd. February 9th, 1938. (510887.)

4096. "Electric measuring instruments." British Thomson-Houston Co., Ltd. February 9th, 1937. (510727.)

4151. "Electric battery lamps." F. J. Miller and N. V. Miller. February 10th, 1938. (Cognate application 3918/39.) (510809.)

4175. "Electric lamp bulbs." W. W. Triggs. (Save Electric Corporation.) February 10th, 1938. (510956.)

4215. "Electric voltage regulators." British Thomson-Houston Co., Ltd. February 12th, 1937. (511145.)

4271. "Electric light fittings." K. S. Adie. February 11th, 1938. (511150.)

4322. "Electric telephone cable installations." Felten & Guilleaume Carlswerk Akt.-Ges. February 25th, 1937 (510811.)

4356. "Control of radio receivers." Radio Gramophone Development Co., Ltd., and W. R. Parkinson. February 11th, 1938. (510895.)

4358. "Television and like systems." Baird Television, Ltd. (Fernseh Akt.-Ges.) February 11th, 1938. (511048.)

4404. "Voltage control in rectifying arrangements." Standard Telephones & Cables, Ltd. February 20th, 1937. (510730.)

4406. "Electron-discharge apparatus." Standard Telephones & Cables, Ltd. March 31st, 1937. (510967.)

4407. "Points indicators on railway track panels." Standard Telephones & Cables, Ltd., A. Brown and T. A. Marshall. February 11th, 1938. (511051.)

4455. "Lanterns for electric lamps." British Thomson-Houston Co., Ltd., and C. W. Wood. February 12th, 1938 (511057.)

4577. "Electric resistance switches." Walturdaw Cinema Supply Co., Ltd., and G. E. Stubbs. February 14th, 1938. (511067.)

4594. "Circuit arrangements including dry rectifiers." Automatic Telephone and Electric Co., Ltd., A. E. Caswell, and C. F. Lawrence. February 14th, 1938. (511159.)

5877. "Electrical communication systems." Telephone Manufacturing Co., Ltd., and L. H. Paddle. February 24th, 1938. (511072.)

6000. "Electrically heated melting pots for die-casting machines." A. Strobel, H. G. Page, and Funditor, Ltd. February 25th, 1938. (510973.)

8279. "Sources of light for projection apparatus." General Electric Co., Ltd. (Patent-Treuhand-Ges. für Elektrische Glühlampen). March 17th, 1938. (510818.)

8399. "Tuning devices for wireless receivers." General Electric Co., Ltd., and W. H. Peters. March 18th, 1938. (510819.)

8564. "Electrical socket couplings, switch-sockets and similar electrical accessories." J. A. Crabtree and Co., Ltd., H. F. McLoughlin and B. G. Harrison. March 21st, 1938. (Cognate application 1969/39.) (511077.)

8565. "Electrical socket couplings, switch-sockets and similar electrical accessories." J. A. Crabtree and Co., Ltd., H. F. McLoughlin and B. G. Harrison. March 21st, 1938. (511078.)

9176. "Wireless signalling systems." General Electric Co., Ltd., N. R. Bligh, J. B. L. Foot, and R. F. Proctor. March 25th, 1938. (511079.)

9930. "Rectification of alternating-currents and voltages." S. F. Warren (Telefunken Ges. für Drahtlose Telegraphie). March 31st, 1938. (510745.)

11903. "Process for the manufacture of flexible electric heating appliances." Elektrowarme Ges. Nokel & Co., Ges. December 11th, 1937. (511085.)

12148. "Electrical conductors." Marbon Corporation. April 29th, 1937. (510747.)

13193. "Protection of electrical plant and apparatus from lightning flashes and/or from electrical disturbances caused by lightning flashes." B. F. J. Schonland. May 3rd, 1938. (510982.)

13447. "Thermionic cathodes." General Electric Co., Ltd., M. Benjamin and C. J. Smithells. May 5th, 1938. (510983.)

14359. "Electric-discharge devices and methods of manufacturing the same." C. Lorenz Akt.-Ges. May 15th, 1937. (510984.)

15643. "Electric condensers." Dubilier Condenser Co. (1925), Ltd., and N. C. Moore. May 25th, 1938. (510917.)

15754. "Supply circuits for luminous electric discharge lamps and tubes." Claude-General Neon Lights, Ltd., and G. T. Kingsley-Lark. May 26th, 1938. (510987.)

16763. "Device for varying the damping of a tuned oscillatory circuit." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. June 7th, 1937. (510919.)

16955. "High-frequency electric arc furnaces for the production of oxides of nitrogen." Soc. Hydro-Electrique Aiguebelette-Bourget., and G. L. Des Ylouses. June 7th, 1938. (510827.)

17505. "Electrical switching apparatus and sets of contact springs therefor." S. D. Vigren and R. A. Svensson. June 13th, 1938. (511092.)

17591. "Telephone systems." General Electric Co., Ltd., G. H. L. Shelley and O. I. Penter. June 14th, 1938. (510752.)

19620. "Electrical apparatus for distance measurements." Sperry Gyroscope Co., Inc. July 3rd, 1937. (511093.)

21263. "Electric-discharge devices." General Electric Co., Ltd. (Patent-Treuhand-Ges. für Elektrische Glühlampen). July 18th, 1938. (Addition to 499897.) (510828.)

21830. "Circuit arrangements for the variation of the transmission properties of an electrical circuit by means of a control voltage." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. November 25th, 1937. (511095.)

25741. "Cross-talk reduction." Standard Telephones & Cables, Ltd. September 22nd, 1937. (510830.)

25760. "Magneto-strictive oscillator." H. Fairbrother (Ataka & Co., Ltd.). September 2nd, 1938. (Convention date not granted.) (510927.)

26007. "Manufacture of electrically insulating tapes." United States Rubber Products, Inc. September 9th, 1937. (511104.)

26178. "Wireless receivers with fading compensation." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. September 10th, 1937. (510831.)

26975. "Short and ultra-short wave radio communication systems." Soc. Francaise Radio-Electrique. September 15th, 1937. (510763.)

28114. "Systems for matching impedances aperiodically." Standard Telephones & Cables, Ltd. October 9th, 1937. (510833.)

30846. "Electric connectors." British Thomson-Houston Co., Ltd. October 25th, 1937. (511005.)

31722. "Systems for the production of direct currents at high tension." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. November 5th, 1937. (511113.)

32903. "Glow-discharge tubes for voltage regulation." Stabilovolt Ges. November 11th, 1937. (Cognate applications. 32904/38, 32905/38, 32906/38, and 32907/38.) (511115.)

33945. "Electron-discharge devices." Standard Telephones & Cables, Ltd. December 31st, 1937. (510842.)

34044. "Photo-electric cells." Electrical Research Products, Inc. December 21st, 1937. (510843.)

35970. "Telephone subset." Standard Telephones & Cables, Ltd. December 24th, 1937. (511119.)

36581. "Leading-in conductors for electric-discharge devices." British Thomson-Houston Co., Ltd. December 17th, 1937. (510846.)

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549. "Ultra-high-frequency electric and electro-magnetic wave transmission systems." Telefunken Ges. für Drahtlose Telegraphie. January 11th, 1938. (511014.)

2035. "Printing-telegraph signalling systems, and devices relating thereto." Standard Telephones & Cables, Ltd. March 5th, 1938. (510853.)

9100. "Electric - discharge tubes." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. March 25th, 1938. (510940.)

13277. "Heterodyne carrier-wave receivers." L. L. De Kramolin. November 5th, 1936. (Divided out of 510941.) (511030.)

20582. "Apparatus comprising a low-permeability core with an inductive winding thereon." L. L. De Kramolin. November 5th, 1936. (Divided out of 510941.) (Addition to 451097.) (511031.)

21818. "Luminescent or light valve screens, more particularly for television purposes." H. E. Sundberg. October 28th, 1937. (Divided out of 12169/37.) (510855.)

CONTRACT INFORMATION

Particulars of work for which tenders are invited, contracts placed, and building schemes promising work for electrical contractors and traders

Contracts Open

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses. Further details of items marked with an asterisk can be obtained from the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, London, S.W.1.

Argentina.—BUENOS AIRES. — October 2nd. Two pumping sets with switchboards, transformers, cable, &c. Argentine National Sanitation Department. (T.Y. 25937/39.)*

Australia. — MELBOURNE.—September 26th. Posts and Telegraphs Department. Telephone transformers. (T. 26136/39.)*

BRISBANE.—October 11th. Electrically driven pumping unit comprising pump, motor, discharge column in well, shafting and control gear, &c. Department of Irrigation, Water Supply & Sewerage, Executive Buildings, George Street, Brisbane. (T. 26172/39.)*

PERTH.—November 2nd. Western Australia Government Tender Board. Supply and delivery of two 500-kW mercury arc rectifiers, switchgear, feeders, control system, &c. (T. 26439/39.)*

Barrhead. — September 14th. Town Council. Sewage purification works, &c. Forms from Leitch & Sharpe, 65, Bath Street, Glasgow, C.2 (deposit £2 2s.). Tenders to Town Clerk.

Canterbury.—September 23rd. Electrical installation for conversion of former hospital into technical institute, for E.C.; R. H. Stevens, director of education, 12, St. George's Place. Deposit: £1 1s.

Dewsbury.—September 11th. Borough Council. Supply of electrical stores. (September 1st.)

East Lothian.—County Council. Various works, including electrical, for adapting part of Castellau Mansion House, Dunbar, as a first-aid post, &c. Specifications from county architect, County Buildings, Haddington.

Eccles.—September 18th. Education Committee. Installation of electric lighting, wiring, &c., open air schools, Peel Green. Borough electrical engineer, Electricity Offices, 1, King Street (deposit £1 1s.).

Egypt.—CAIRO.—September 30th. Four pumps for Kafr El Elw central power station. Tanzim Department, Ministry of Public Works. (T. 26146/39.)*

October 18th. Extension of the electrical network at Damietta. Municipalities Department. (T. 26152/39.)*

September 21st. Supply, delivery and erection of equipment for extension of electric light installation at Minieh. (T. 26151/39.)*

Glasgow.—September 15th. Corporation. Installation of a low-pressure hot-water system in new reception and sanatorium blocks at Woodilee Mental Hospital extension, together with the supply and installation of electrode water heating units and controls, electrode steam boiler units and controls for kitchen, &c., apparatus, and supply only of immersion heater units for the domestic hot water service. Forms (£2 2s.) from the Medical Officer of Health, Sanitary Chambers, 23, Montrose Street, Glasgow. Tenders to Town Clerk.

High Wycombe.—September 8th. Town Council. Wiring and new fittings at town hall. Specifications from borough surveyor, Municipal Offices.

India.—NEW DELHI.—June 9th, 1940. Indian Stores Department Electrical Section. AC and DC table fans. (T. 35343/39.)*

SIMLA.—September 14th. Indian Stores Department, Electrical Branch. Three single-operator DC arc welding generators, rated at 250 A, and two 12/14 BHP Diesel oil engines. (T. 26131/39.)*

Lincoln.—September 25th. North Lindsey Water Board. Electrically driven pumping plant for two pumping stations. (See this issue.)

London.—Great Western Railway. September 21st. Various stores. (See this issue.)

Manchester.—September 21st. Electricity Committee. Switchgear bus-bar protective equipment. (August 25th.)

Montrose. — September 23rd. Town Council. Electric lighting work at Rossie Island housing estate (44 houses). Tenders to Town Clerk.

Newport (MON).—September 11th. Electricity Department. One turbine-driven and two motor-driven boiler feed pumps. (August 25th.)

New Zealand.—WELLINGTON.—November 14th. Supply of 50-kV, three-phase, outdoor switchgear and steelwork complete with insulators and accessories. (T. 26179/39.)*

September 20th. 60,000 porcelain or composition insulators. Stores Division, General Post Office, Wellington, C.1. (T. 25828/39.)*

Pembrokeshire.—September 29th. Renewal of fog-signalling machinery and installation of electric light generating plant at the South Bishop lighthouse off the Pembrokeshire coast. Secretary, Trinity House, Tower Hill, London, E.C.3.

Roxburgh.—September 18th. County Council. Electrical work at thirty-four houses. Schedules from Wilson & Wilson, architects, 39, Vicar Street, Falkirk; tenders to County Clerk, Newtown St. Boswells.

Salford.—September 19th. Corporation. Rubber-insulated cables and electric lamps. (See this issue.)

South Africa.—JOHANNESBURG. — September 13th. City Council. Twelve 250-MVA and 24 150-MVA metal-clad triple-pole, oil-immersed circuit-breakers. (T. 25985/1939.)*

September 13th. Eleven lightweight two-seater passenger electric coupés and three 5-8-cwt. electric delivery vans having two-seater driving cabins. (T. 26293/39.)*

September 16th. Trolley-bus overhead equipment. (T. 26113/39.)*

November 17th. 33-kV switchgear and auxiliary plant. (T. 25663/39.)*

PRETORIA.—September 14th. Public Works Department. Motors and switches, rectifier, drum controller and grid resistance starter. (T. 26125/39.)*

September 28th. Union Tender and Supplies Board. Low-voltage cable and end and joint boxes. (T. 26367/39.)*

PORT ELIZABETH. — September 14th. Electrical Engineer's Department. Galvanised steel poles, time switches, tail end switches and extra-high-voltage cable. (T. 26353/39.)*

Warrington. — September 18th. Electricity Department. Extra-high and low-voltage, paper and lead-covered and other cables; earthenware conduits and concrete slabs, tiles and covers for twelve months. (September 1st.)

Watford. — Electricity Department. Extra-high-voltage and low-voltage cables and meters for twelve months. (See this issue.)

Orders Placed

Glasgow.—Education Committee. Accepted. Alterations to heating system in Springfield school (£124).—G. N. Haden & Sons.

Health Committee. Accepted. Heating installation at clinic in Cowcaddens (£969).—D. McMillan.

Manchester.—Electricity Committee. Accepted. Annual requirements of materials. Weldless steel lamp columns and fittings.—Bromford Tube Co., Ltd.; Newport and South Wales Tube Co., Ltd. 6,600-V cables.—W. T. Glover & Co., Ltd.; Standard Telephones & Cables, Ltd. 40,000-kVA transformers, &c.—Metropolitan-Vickers Electrical Co., Ltd.; Ferranti, Ltd. Mercury-arc rectifier equipments.—Hewittic Electric Co., Ltd.; Nevelin Electric Co., Ltd.; Electric Construction Co., Ltd. Emergency lighting sets.—Crossley Bros., Ltd.

Town Hall Committee. Accepted. Ventilation and filtration equipment.—Keith Blackman, Ltd. Emergency lighting equipment.—Petters, Ltd.

Health Committee. Accepted. Installation of internal telephones at Crumpsall Hospital.—Reliance Telephone Co., Ltd.

Sheffield.—Education Committee. Accepted. Electrical installation at Carterknowle Road school (£315).—T. W. Sampson & Co.

Electricity Committee. Accepted. Erection of electrically operated crane at Blackburn Meadows power station (£2,786).—Babcock & Wilcox, Ltd. 33-kV gas-filled cable and jointing (£21,894).—W. T. Glover & Co., Ltd.

Workington. — Electricity Committee. Recommended. One 500-kVA transformer (approx. £365).—Ferranti, Ltd. Three high-voltage switches (approx. £125 each) and three low-voltage switches (approximately £100 each).—Switchgear & Cowans.

TRADE MARK APPLICATIONS

THE following are among the recent applications for British trade marks. Objections against any of the proposed marks may be entered within one month from August 30th.

Cross and Circle (design only). No. 586903. Class 8 (III). Magnetic compasses and other aviation instruments and apparatus. R. B. Pullin & Co., Phœnix Works, Great West Road, Brentford, Middlesex.

Bivitone. No. 605786. Class 9 (IV). Loudspeakers. Vitavox, Ltd., Westmoreland Road, Queensbury, London, N.W.9.

Ferrospeed. No. 606314. Class 9 (IV). Iron and steel electrodes for electric welding. The Ferro-Arc Welding Co., Ltd., Thames House, Millbank, Westminster, London, S.W.1.

Lysholm-Schonander (lettering and design). No. 604567. Class 10 (IV). X-ray screens. Georg Schonander, trading as Ingeniors Firma Georg Schonander, Stockholm, Sweden (British representatives, Marks & Clerk, 57-58, Lincoln's Inn Fields, London, W.C.2.).

INFORMATION DEPARTMENT

GENERAL inquiries from readers relating to sources of electrical goods, makers' addresses, &c., are replied to by our Information Department through the post. Inquiries should be accompanied by a stamped addressed envelope.

Our extensive records enable us to reply to most queries, but occasionally we ask for our readers' assistance in tracing names and addresses not known to us. We should be glad to have such information regarding the following:—

HEARSON drying oven.

BRONTO wired lath to fit round a room, which on being pressed at any point closes a circuit and rings a bell.

Hedge trimming machine.

Contracts in Prospect

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Aberdeen.—Houses, for Corporation; city architect.

Alnwick.—Houses (38), for the R.D.C.; surveyor.

Alton (HANTS).—Extensions to Eggars Grammar School; governors.

Ashington.—Reconstruction of Princess Ballroom; A. Shepherd, Ashington.

Ayr.—Store for A. G. Barr & Co., Ltd., 1,306, Gallowgate, Glasgow.

Barnsley.—Houses, New Street rehousing scheme, for T.C.; borough engineer, Town Hall.

Basingstoke.—Extensions to offices and works, for Kelvin Bottomley and Baird, Ltd.; Tigwell and Stephens, Ltd., builders, Wote Street.

Birmingham.—Extensions to works, for West Bros.; Sanders (Builders), Ltd., 202, Stratford Road, Shirley.

Bishops Cleeve (GLOS).—Two factories; S. Smith & Sons, Ltd.

Bolton.—Houses, Willows Lane; borough engineer. Works extensions; Bolton Gate Co., Ltd. Extensions, Roscoe Fold school; Rev. A. Grimes. Clinic, Townleys Hospital; borough engineer. Additions, Lincoln Mills; R. Entwistle & Co., Ltd. Salvation Army Hall, Long Lane estate; M. W. Gill.

Bulkington (WILTSHIRE).—Dairy, Poplar Farm, for London Co-operative Society, Ltd.; J. H. Blackford & Son, builders, Calne.

Burnley.—Central garage, workshops, &c.; borough surveyor.

Bury.—School, Seedfield; borough engineer.

Camborne (REDRUTH).—Houses, Lanner; U.D.C. surveyor.

Carlisle.—School, for the City Council; P. Dalton, city engineer, 18, Fisher Street.

Cheltenham. — Factory extensions; Spirax Manufacturing Co., Ltd. Factory; Globe Joinery Co. Development, estate; Elmfield Park Estate Co., Ltd. Houses (11); Western Estates, Ltd.

Chesterfield.—Institute for Chesterfield Settlement Guild Committee (F. B. Briggs, secretary); C. Bond, architect, 71a, Low Pavement.

Cleckheaton.—Additions to factory, for C. Hirst & Sons, Ltd. Houses (10), Hunsworth; Robinson & Crowther.

Colwyn Bay.—Houses; J. L. Griffiths, architect, 70, High Street, Rhyl. Houses, for T.C.; W. J. Dunning, borough surveyor.

Coventry.—School; A. Rolf Hellberg, architect, 13, Queen Victoria Road. Shops, for Sarzita Estates, Ltd.; C. Redgrave & Son, architects, The Quadrant, Warwick Road.

Cradley Heath.—Factory, for Forward Chain & Oddwork Manufacturing Co.; D. Price, builder, Cradley Road, Cradley Heath.

Croydon.—Extensions to nurses' home; Commercial Structures, Ltd., builders, Staffa Road, Leyton, E.10.

Denbigh.—Houses (26); P. Griffiths, builder, Tre Llewellyn Road, Rhyl.

Derbyshire.—Isolation block and separate clinic and maternity home, for C.C.; county architect, County Offices, St. Mary's Gate, Derby.

Eastbourne. — Offices, for Barclays Bank Ltd.; Clayton & Black, architects, 10, Prince Albert Street, Brighton.

East Ellce.—New Council offices, for R.D.C.; A. E. Palmer, Council's architect.

Edgware. — Extensions, community centre; Granville Streatfield, architect, 13, New Square, Lincoln's Inn, London, W.C.2.

Eire.—(SCHULL).—Hospital, for West Cork Board of Health (£9,000). (CASTLEPOLLARD).—Nursery and maternity block, &c., and new chapel, The Hospital; F. D. Shortall, quantity surveyor, 10, Leinster Street, Dublin. (LOUGHREA).—Alterations and additions, County Home, for Galway Board of Health; W. H. Byrne & Son, architects, 20, Suffolk Street, Dublin.

Erith.—Factory and offices, for Burt, Boulton & Haywood; Thomas & Edge, Ltd., builders, 25, Greens End, London, S.E.18.

Exeter.—Extensions, isolation hospital; city engineer.

Glasgow.—Nurses' home, Mearnskirk Hospital; city architect. Clinic, Pollokshaws, city architect. Furniture depository, for Garlick, Burrell & Edwards, Ltd.; P. Thaw, builder, 660, Duke Street.

Greenford.—Block of shops, flats and garages; H. Kenchington, architect, 7, Staple Inn, Holborn, W.C.1.

Halifax.—Extensions to factory, Binns and Berry Bros.

Harmondsworth (MIDDLESEX). — Factory; W. S. Try, Ltd., builders, High Street, Cowley, Uxbridge.

Hawarden (FLINT).—Houses); G. J. Reidford, engineer and surveyor, Council Offices, Hawarden.

Hayling Island.—Hospital, for Lord Mayor Treloar Cripples' Hospital; C. E. Elcock, architect, 60, Strand, London, W.C.2.

Hebburn-on-Tyne. — Offices for R. Frazer and Sons, Ltd.; D. Glen, Ltd., builders, Back Queens Road, Jarrow-on-Tyne.

Hexham.—Council offices.

Holland.—County hospital (£41,708), for C.C.; A. P. C. Wray, Ltd., builders, Hoddesdon.

Hull.—Factory, for R. Silcock & Sons, Ltd.; Simplex Concrete Piles, Ltd., builders, 127, Victoria Street, London, S.W.1.

Ilford.—Development, Uplands estate; J. Giles.

Kettering.—Offices for Britannic Assurance Co., Ltd.; J. Searson, contractor, Station Road, Sutton-in-Ashfield, Notts.

Kirkby. — Shops; J. Bickerstaffe, builder, 112, Yew Tree Road, Ormskirk.

Lancaster.—School, for Lancaster Association of School Managers (secretary, E. J. Trafford, 43, Regent Street, Lancaster); F. Thorpe & Whyman, architects, Union Bank Chambers, Church Lane, Oldham. Chapel, for trustees of the Methodist Union; F. Howarth, architect, L.R.I.B.A., 10, Theatre Street, Preston. Works, Lancaster Bricks, Ltd.

Leicestershire.—School, Belvoir; county architect.

Leigh.—R.C. senior schools; J. G. Prestwich & Sons, architects, Bradshawgate Chambers.

Lichfield.—Maternity blocks, Lichfield Victoria Hospital; J. R. Deacon, Ltd., contractors, Lombard Street, Lichfield.

Lincoln.—Hostel, dining hall and kitchens, for Lincoln Diocesan Training College; John Cawley, Ltd., contractors, 37, Leen Side, Nottingham.

Liverpool.—Houses (18), for District Estates, Ltd.; A. E. Shennan, architect, 17, North John Street. Six-storey building for Upsons, Ltd., 7/10, Great Dover Street, London, S.E.1. Factory, for Bradley's (Chester), Ltd.; E. B. Bailey, architect, 51, North John Street.

Long Eaton.—Bedding factory, Toten, for C.W.S., Ltd., Balloon Street, Manchester.

Luton.—Factory, for M.R.C., Ltd.; W. H. Cahn, architect, 65, Chancery Lane, London, W.C.2.

Manchester.—Factory, for William Morris Press, Ltd.; David Walton & Co., contractors, Clarendon Road, Cross Lane, Salford, 5. Rebuilding C.E. school; Taylor & Young, architects. Two R.C. schools; Hill, Sandy & Norris, architects. Police section house; city architect. R.C. senior school; C. Musker Bros., Ltd.

Millom.—New Council offices.

Milnthorpe.—Extensions to milk canning factory, for Libby, McNeill and Libby; Halstead Best, architect, Clifton Street, Blackpool.

Monkseaton (NORTHUMBERLAND).—R.C. school; Ball Brothers, builders, Front Street, Preston, North Shields.

Moseley (BIRMINGHAM). — Rebuilding Presbyterian Church; S. F. Swift & Sons, Ltd., builders, 200, Alcester Street, Birmingham.

Mossley (LANCASHIRE).—Extensions to works for Glover Bros., Ltd.; Edwin Marshall & Sons, Ltd., builders, Cockbrook, Manchester.

Northern Ireland.—(BELFAST).—Nurses' home; city surveyor.

Northfleet.—Houses (44), Perry Street estate (£17,527), for U.D.C.; J. B. Lingham, builder, 1, The Hill, Gravesend.

North Shields.—Hotel, for McEwan and Co., Ltd.; B. Peel, Ltd., builders, East Mill Works, North Shields.

Northampton.—Houses (17), Acme Building Co., Friars Avenue. Houses (12); Chowns, Ltd., Malcolm Drive.

Northumberland.—Police houses, for C.C.; county architect, County Hall, Newcastle-on-Tyne.

Plymouth. — Houses; Colborne's Estates, Ltd. Houses; F. Westcott, Flats; T. C. Jeffery. Factory; L. Jeffery & Son, Ltd.

Prescot. — Houses; C. H. Reakes, builder, 138, Dragon Lane, Whiston.

Preston.—School, for R.C. Diocesan Board; R. Mercer, architect, 11, Chapel Street, Preston.

Ruislip.—Extensions to factory, for Air Control Installations, Ltd., 430, Victoria Road.

Seaton Valley (NORTHUMBERLAND).—Houses, for the U.D.C.; J. E. Gardner, builder, Coatsworth Road, Gateshead.

Sheffield. — Houses, Parson Cross estate; Insley & Son, Ltd. Highway depots; city engineer. Rebuilding Yew Tree Inn; Duncan Gilmour & Co., Ltd. Development; Fitzalan Howard Estates, Ltd. Flats, Tapton Hill; Graves Trust. Houses; J. T. Redmile. Houses, Barncliffe Drive; Simpson Bros., Ltd. Works and showrooms; Credland Bros., Ltd. Offices and shops; G. Tucker & Co., Ltd. Vicarage; Sheffield Diocesan Trust. Factory; W. R. Swann & Co., Ltd.

Shilbottle (NORTHUMBERLAND).—School; F. M. Dryden, architect, 6, Market Street, Newcastle-on-Tyne.

Shurdington (GLOS).—Houses; H. O. Hawkins.

Spenborough.—Houses; Windy Bank Lane; U.D.C. surveyor, Town Hall, Cleckheaton.

Stonehouse.—Alterations and additions, Wesley Hall; Wesleyan trustees.

Sunderland.—Church; W. and T. R. Milburn, architects, 17, Fawcett Street.

Tamworth.—Houses; George Linnecor & Sons, 154, New Town Row, Aston Cross, Birmingham, £10,900.

Twickenham. — Furniture depository, St. Margaret's Road; Pickfords, Ltd., 205, High Holborn, W.C.1.

Ulverston.—Hospital; C. B. Pearson & Son, architects, 18, Dalton Square, Lancaster.

Warwickshire.—Library, completion of college of technology and schools; county architect, Shire Hall, Warwick.

Whitton.—Houses (30), Percy Street; Wates, Ltd., London Road, Norbury.

Workington.—Factory for the Cumberland Cloth Co.

Wrexham.—Extensions, Denbighshire Technical Institute.

York.—Additions to works; Rowntree & Co., Ltd. Houses; C. H. Sharp, 19, Kexby Avenue.

B.B.C. Changes

IT was announced on Monday that London has ceased to be the headquarters of the British Broadcasting Corporation. Several new centres are in use in various parts of the country. Until further notice only one programme is being broadcast, on the wavelengths of the Scottish Regional and North Regional transmitters (391 and 449 metres). The television service has been suspended until further notice.